

Environmental Projects: Volume 12

Friable Asbestos Abatement, GDSCC

N91-13805

Uncles
0317950

63/45

(NASA-CR-188976) ENVIRONMENTAL PROJECTS.
VOLUME 12: FRIABLE ASBESTOS ABATEMENT, GDSCC
(JPL) 210 0
CSCL 138



JPL
Jet Propulsion Laboratory
California Institute of Technology

NASA
National Aeronautics
Space Administration

Environmental Projects: Volume 12

Friable Asbestos Abatement, GDSCC

Goldstone Deep Space Communications Complex

The work described in this publication was carried out under the direction of the Jet Propulsion Laboratory, California Institute of Technology, and was supported by the National Aeronautics and Space Administration.

Reference herein to any specific commercial product, process, or service by trade name, or manufacturer does not necessarily constitute an endorsement by the United States Government, the National Aeronautics and Space Administration, or the Jet Propulsion Laboratory, California Institute of Technology.

ABSTRACT

The Goldstone Deep Space Communications Complex (GDSCC), located in the Mojave Desert about 40 miles north of Barstow, California, and about 160 miles northeast of Pasadena, is part of the National Aeronautics and Space Administration's (NASA's) Deep Space Network, one of the world's largest and most sensitive scientific telecommunications and radio navigation networks. The Goldstone Complex is managed, technically directed, and operated for NASA by the Jet Propulsion Laboratory (JPL) of the California Institute of Technology in Pasadena, California.

Activities at the GDSCC are carried out in support of six large parabolic dish antennas. These activities may give rise to a variety of environmental hazards, particularly the danger of exposure of GDSCC personnel to asbestos fibers that have been shown to be responsible for such serious ailments as asbestosis, lung cancer, and mesothelioma.

Asbestos-containing materials (ACMs) were used in the construction of many of the approximately 100 buildings and structures that were built at the GDSCC during a 30-year period from the 1950s through the 1980s. Most of the construction took place before it was known that asbestos could be hazardous to human health.

Thus, M. B. Gilbert Associates (MBGA), Long Beach, California, was retained by JPL in 1986 and 1987 to carry out two asbestos field surveys at the GDSCC: a comprehensive survey to locate, classify and quantify all ACMs then in use in the diverse buildings and a more limited survey of selected roofs and boilers. The MBGA reports on these surveys provided guidance and suggestions for asbestos abatement and management plans for the GDSCC. An expanded version of the two survey reports was published as JPL Publication 87-4, Volume 4, Environmental Projects: Asbestos Survey (February 1, 1988).

Friable asbestos is material that contains more than one-percent by weight of asbestos and can easily be crumbled, pulverized, or reduced to powder by hand pressure when it is dry. Because this form of asbestos is most likely to release potentially dangerous asbestos fibers into the environment, its abatement and removal received top priority at the GDSCC.

In December 1987, Engineering-Science, Inc., Pasadena, California, submitted a Preliminary Engineering Report to JPL that dealt with friable asbestos abatement involving the removal of asbestos-containing thermal pipe and boiler insulation from 10 buildings/structures, and the removal and replacement of three boilers and their piping insulation.

The present report, which describes the friable asbestos-abatement program at the GDSCC, consists of the text, illustrations, and tables that describe the friable asbestos abatement carried out at the GDSCC from December 21, 1988, to its end on May 11, 1989. All records and archival material pertinent to the implementation of the friable asbestos-abatement program can be found in Friable Asbestos Abatement Supplemental Records, JPL D-7450 (internal document), Jet Propulsion Laboratory, Pasadena, California.

As a result, friable asbestos, as a potential environmental danger, has now been eliminated from the GDSCC.

PRECEDING PAGE BLANK NOT FILMED

GLOSSARY

ACM	Asbestos Containing Material
AIHA	American Industrial Hygiene Association
APCD	Air Pollution Control District
AQMD	Air Quality Management District
BLM	U.S. Bureau of Land Management
CAC	California Administrative Code
Cal/OSHA	California Occupational Safety and Health Administration
CFR	Code of Federal Regulations
DHS	Department of Health Services (California)
DOSH	Division of Occupational Safety and Health (California)
DSCC	Deep Space Communications Complex
DSN	Deep Space Network
DSS	Deep Space Station
EIC	Engineer in Charge
EPA	U.S. Environmental Protection Agency (see U.S. EPA)
E-S	Engineering-Science, Inc., Pasadena, California
f/cc	fibers per cubic centimeter
FAC	Facility Asbestos Coordinator
FEV	forced expiratory volume (lungs)
FVC	forced vital capacity (lungs)
GDSCC	Goldstone Deep Space Communications Complex
HEF	High-Efficiency (Antenna)
HEPA	High-Efficiency Particulate Air (Filter)
HVAC	Heating, Ventilating and Air Conditioning
JPL	Jet Propulsion Laboratory
LRWQCB	Lahontan Regional Water Quality Control Board

MBGA	M. B. Gilbert Associates, Long Beach, California
MSDS	Material Safety Data Sheet
MSHA	Mine Safety and Health Administration
MTF	Microwave Test Facility
NASA	National Aeronautics and Space Administration
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NIOSH	National Institute for Occupational Safety and Health
NOAA	National Oceanic and Atmospheric Administration
NTC	National Training Center (U.S. Army)
OSHA	Occupational Safety and Health Administration
PAT	Proficiency Analytical Testing
PEL	Permissible Exposure Limit
PER	Preliminary Engineering Report
R&D	research and development
RI	Refractive Index
SAI	Spray-Applied Insulation
SBAPCD	San Bernardino Air Pollution Control District
SETI	Search for Extraterrestrial Intelligence
SOPs	Standard Operating Procedures
STS	Space Transportation System (Space Shuttle)
TDA	Office of Telecommunications and Data Acquisition (JPL)
TDS	Total Dissolved Solids
TSCA	Toxic Substances Control Act
TWA	Time-Weighted Average
U.S. EPA	United States Environmental Protection Agency (see EPA)
VLBI	Very Long Baseline Interferometry

CONTENTS

I.	INTRODUCTION	1-1
A.	STATEMENT OF PROBLEM	1-1
B.	THE NATURE OF ASBESTOS	1-1
C.	ENVIRONMENTAL AND HEALTH PROBLEMS ASSOCIATED WITH ASBESTOS	1-2
	1. History of Asbestos Use	1-2
	2. History of Asbestos-Caused Diseases	1-3
D.	GENERAL CHARACTERISTICS OF ASBESTOS-CAUSED DISEASES	1-8
	1. Inhalation and Ingestion of Asbestos Fibers	1-9
	2. Relationship Between Type of Asbestos Fibers and Disease	1-9
	3. Theories as to How Asbestos Fibers Cause Disease	1-9
E.	ASBESTOS-CAUSED DISEASES	1-10
	1. Asbestosis	1-10
	2. Lung Cancer	1-10
	3. Mesothelioma	1-10
	4. Gastrointestinal Cancers	1-11
	5. Potential Health Risk as a Function of Airborne Asbestos Levels and Exposed Population Exposure	1-11
II.	REGULATIONS THAT GOVERN MANAGEMENT OF ASBESTOS	2-1
A.	INTRODUCTION	2-1
B.	FEDERAL REGULATIONS	2-1
C.	CALIFORNIA REGULATIONS	2-2
	1. Water Quality Requirements: Lahontan Regional Water Quality Control Board	2-2
	2. Air Quality Requirements: San Bernardino Air Pollution Control District (SBAPCD)	2-3

3.	Hazardous Waste Requirements: California Department of Health Services	2-3
4.	California OSHA	2-3
5.	Local Requirements: Roofing	2-4
D.	NASA GUIDANCE	2-4
E.	SUMMARY OF ASBESTOS REGULATIONS	2-4
III.	THE GOLDSTONE DEEP SPACE COMMUNICATIONS COMPLEX (GDSCC)	3-1
A.	LOCATION OF THE GDSCC	3-1
B.	FUNCTIONS OF THE GDSCC	3-1
C.	FACILITIES AT THE GDSCC	3-3
D.	ANTENNA STATIONS AT THE GDSCC	3-7
1.	Echo Site (DSS-12)	3-7
2.	Venus Site (DSS-13)	3-7
3.	Mars Site (DSS-14 and DSS-15)	3-7
4.	Apollo Site (DSS-16, DSS-17 and DSS-18)	3-8
5.	Mojave Base Site (NOAA Antenna)	3-8
E.	SUPPORT FACILITIES AT THE GDSCC	3-9
1.	Goldstone Dry Lake Airport	3-9
2.	Microwave Test Facility and Fire-Training Area	3-9
3.	Miscellaneous Buildings in the GDSCC Area	3-9
4.	Off-Site Facility at Barstow, California	3-9
F.	NON-STRUCTURAL SUPPORT FACILITIES AT THE GDSCC	3-9
1.	Transportation Network	3-9
2.	Utilities and Services	3-9
G.	SOLID-WASTE MANAGEMENT FACILITIES AT THE GDSCC	3-11
H.	WASTEWATER MANAGEMENT FACILITIES AT THE GDSCC	3-11

I.	OPERATIONAL RELATIONSHIPS BETWEEN THE GDSCC AND FORT IRWIN	3-11
J.	NATURAL ENVIRONMENTAL ASPECTS OF THE GDSCC	3-12
	1. Geology	3-12
	2. Hydrology	3-12
	3. Climatic Conditions	3-12
IV.	THE ASBESTOS SURVEY AT THE GDSCC	4-1
A.	INTRODUCTION	4-1
B.	ASBESTOS-SURVEY OBJECTIVES	4-2
C.	SCOPE OF THE ASBESTOS SURVEY	4-3
	1. Selection of Buildings and Structures to be Investigated	4-3
	2. Selection of Roofs and Boilers of Specific Buildings to be Investigated	4-3
	3. Asbestos Uses Included in the Survey of Buildings/Structures at the GDSCC	4-3
	4. Asbestos Uses Included in the Survey of Roofs and Boilers	4-3
D.	ORGANIZATION OF JPL PUBLICATION 87-4, VOLUME 4, <u>ENVIRONMENTAL PROJECTS: ASBESTOS SURVEY</u> (FEBRUARY 1, 1988)	4-4
V.	SUMMARY AND CONCLUSIONS OF THE ASBESTOS SURVEY AT THE GDSCC . . .	5-1
A.	GENERAL FINDINGS	5-1
	1. Occurrences and Uses of Asbestos in Buildings/Structures at the GDSCC	5-1
	2. Occurrences of Asbestos-Containing Materials in Roofs and Boilers at Specified Buildings at the GDSCC . . .	5-2
	3. Incidental Uses of Asbestos-Containing Material at the GDSCC	5-7
	4. Quantities of Asbestos in Buildings and Structures at the GDSCC	5-8

5.	Estimated Quantities of Asbestos-Containing Materials Found in Roofing Materials and Boiler Insulation at the GDSCC	5-8
6.	Asbestos-Sampling Programs	5-11
B.	CONDITION OF ASBESTOS IN BUILDINGS AND STRUCTURES AT THE GDSCC	5-11
C.	RATIONALE FOR SUGGESTED TIMING OF ASBESTOS ABATEMENT	5-12
VI.	FRIABLE ASBESTOS ABATEMENT PROGRAM AT THE GDSCC	6-1
A.	INTRODUCTION	6-1
B.	GENERAL COMMENTS	6-2
1.	Condition of Asbestos-Containing Pipe Coverings at the GDSCC Before the Asbestos-Abatement Program	6-2
2.	Condition of Boilers at the GDSCC Before the Asbestos-Abatement Program	6-2
C.	ASBESTOS-ABATEMENT ALTERNATIVES THAT WERE CONSIDERED IN LIEU OF AN ASBESTOS-ABATEMENT PROGRAM THAT REMOVED <u>ALL</u> FRIABLE ASBESTOS FROM PIPE INSULATION AND BOILERS	6-2
1.	Alternative One: No Action	6-2
2.	Alternative Two: Removal of Only the Friable Asbestos-Covered Pipe Fittings During Boiler Removal and Replacement	6-3
3.	Alternative Three: Removal of Only the Friable Asbestos-Covered Pipe Fittings and Pipes During Boiler Removal and Replacement; Encapsulation of Other Friable Asbestos	6-3
4.	Alternative Four: Complete Removal of Friable Asbestos From Pipe Insulation and Boilers at the GDSCC	6-3
D.	DETAILS CONCERNING TOTAL FRIABLE-ASBESTOS ABATEMENT	6-4
1.	General Considerations	6-4
2.	Air Monitoring	6-5
3.	Duties and Responsibilities of the Friable Asbestos Abatement Contractor	6-5

E.	REPLACEMENT OF BOILERS AT THE GDSCC THAT CONTAINED OR WERE ASSOCIATED WITH FRIABLE ASBESTOS	6-6
F.	ACTUAL IMPLEMENTATION OF THE FRIABLE ASBESTOS ABATEMENT PROGRAM AT THE GDSCC	6-6
G.	BUILDING-BY-BUILDING DESCRIPTION OF FRIABLE ASBESTOS ABATEMENT AT THE GDSCC	6-7
1.	Echo Site	6-15
a.	<u>Building G-21</u>	6-15
b.	<u>Building G-23</u>	6-27
c.	<u>Building G-26</u>	6-27
d.	<u>Building G-33</u>	6-27
e.	<u>Building G-38</u>	6-50
2.	Venus Site	6-50
a.	<u>Building G-51</u>	6-50
3.	Microwave Test Facility	6-69
a.	<u>Building G-72</u>	6-69
4.	Mars Site	6-69
a.	<u>Building G-86</u>	6-69
3.	Mojave Base Site	6-88
a.	<u>Building M-6</u>	6-88
b.	<u>Building M-9</u>	6-88
VII.	CERTIFICATION	7-1

APPENDIXES

A.	TERMINOLOGY AND DEFINITIONS OF WORDS AND TERMS ASSOCIATED WITH ASBESTOS IN THE ENVIRONMENT	A-1
B.	NASA OCCUPATIONAL HEALTH OFFICE GUIDELINES (1983) FOR ASBESTOS HAZARD-ASSESSMENT AND ABATEMENT	B-1
C.	LETTERS AND DISCLAIMERS, SENT FROM M. B. GILBERT ASSOCIATES TO THE JET PROPULSION LABORATORY, THAT ACCOMPANIED SUBMITTED REPORTS DESCRIBING THE TWO ASBESTOS FIELD SURVEYS CONDUCTED AT THE GOLDSTONE COMPLEX	C-1

D.	BUILDING-BY-BUILDING SAMPLE RESULTS OF ASBESTOS SURVEY AT THE GDSCC/BARSTOW	D-1
E.	BIBLIOGRAPHY OF PERTINENT REGULATORY DOCUMENTS DEALING WITH ASBESTOS	E-1
F.	LETTER AND ACKNOWLEDGMENT SHEET CONCERNING ASBESTOS AWARENESS SENT BY J. E. McPARTLAND, MANAGER OF THE GDSCC, TO ALL GDSCC EMPLOYEES	F-1
G.	GROUPS INVOLVED IN THE FRIABLE-ASBESTOS REMOVAL WORK AT THE GDSCC	G-1
H.	UNIFORM HAZARDOUS WASTE MANIFEST FOR THE TRANSPORT OF FRIABLE ASBESTOS DEBRIS FROM THE GDSCC TO A HAZARDOUS WASTE LANDFILL IN JOSEPH CITY, ARIZONA	H-1

Figures

1.	Modes and Rates of Asbestos Fiber Dispersal	1-4
2.	Geographic Relationship of the Goldstone Deep Space Communications Complex to JPL in Pasadena	3-2
3.	The Three-Continent NASA Deep Space Network as It Exists in 1990	3-4
4.	Schematic Map of the Goldstone DSCC Showing Locations of the Five NASA Deep Space Stations (DSSs) and the Mojave Base Station Operated by NOAA	3-5
5.	Major Roads Leading to and at the Goldstone DSCC	3-10
6.	Echo Site: Plot Plan	6-16
7.	Echo Site: Administration and Cafeteria Building G-21	6-22
8.	Typical Asbestos-Containing Floor Tiles in Building G-21 and in Many Other Buildings at the GDSCC.	6-23
9.	Echo Site: Building G-21. BEFORE Asbestos-Removal. Mechanical Equipment Room 127 With Pipe Lagging Containing Friable Asbestos	6-24
10.	Echo Site: Building G-21. AFTER Asbestos-Removal. Mechanical Equipment Room 127 With Friable Asbestos. Pipe Lagging Removed and Replaced With Armaflex and Fiberglass Insulation	6-25
11.	Echo Site: Building G-21, Boiler Room 128 Showing Typical Pipe Lagging Containing Friable Asbestos	6-26
12.	Echo Site: Dormitory Building G-23	6-32

13.	Echo Site: Control Building G-26	6-40
14.	Echo Site: Roofing Material of Control Building G-26	6-41
15.	Echo Site: Engineering and Communications Building G-33	6-49
16.	Echo Site: Building G-33. BEFORE Asbestos Removal. Mechanical Equipment Room 141 With Pipe Lagging Containing Friable Asbestos	6-51
17.	Echo Site: Building G-33. AFTER Asbestos Removal. Mechanical Equipment Room 141 With Asbestos Pipe Lagging Removed and Replaced With Armaflex Insulation	6-52
18.	Echo Site: Network Laboratory and Maintenance Facility Building G-38	6-58
19.	Echo Site: Network Laboratory and Maintenance Facility Building G-38	6-59
20.	Echo Site: Building G-38. BEFORE Asbestos Removal. Mechanical Equipment Room 115 With Pipe Lagging Containing Friable Asbestos	6-60
21.	Echo Site: Building G-38. AFTER Asbestos Removal. Mechanical Equipment Room 115 With Friable Asbestos Pipe Lagging Removed and Replaced With Armaflex and Fiberglass Insulation	6-60
22.	Venus Site: Existing Site Plan Before Construction Began for New 34-Meter Antenna	6-62
23.	Venus Site: Existing Site Plan and Site Plan for New 34-Meter Antenna Now Under Construction	6-63
24.	Venus Site: Control Building G-51	6-68
25.	Microwave Test Facility Plot Plan	6-70
26.	Microwave Test Facility: Microwave Test Facility Building G-72	6-77
27.	Microwave Test Facility: Roofing Material of Microwave Test Facility Building G-72	6-78
28.	Microwave Test Facility: Building G-72. BEFORE Asbestos Removal. Mechanical Equipment Room 111 With Pipe Lagging Containing Friable Asbestos	6-79
29.	Microwave Test Facility: Building G-72. AFTER Asbestos Removal. Mechanical Equipment Room 111 With Friable Asbestos Pipe Lagging Removed and Replaced With Armaflex and Fiberglass Insulation	6-80

30.	Mars Site: Plot Plan	6-81
31.	Mars Site: Operations Support Building G-86	6-86
32.	Mars Site: Roofing Material of Operations Support Building G-86	6-87
33.	Mojave Base Site: Plot Plan	6-89
34.	Mojave Base Site: Telemetry Building M-6	6-92
35.	Mojave Base Site: Generator Building M-9	6-94
36.	Echo Site: Fire Line Pump House G-22	6-96
37.	Echo Site: Office and Storage Building G-27	6-98
38.	Venus Site: 30' Hydro-Mech and Transmitter Building G-58	6-100
39.	Echo Site: Asbestos-Containing Insulation Around Fire System Water Supply Pipe Exterior to Fire Line Pump House. G-22 Has Typical Asbestos-Containing Insulation Covering Exterior Pipes That Enter or Leave Buildings G-22, G-27, G-38, G-58 and M-6 at the GDSCC	6-101
40.	Illustration of "Glove Bag" Apparatus Used in the Removal of Small Areas of Asbestos	6-102

Tables

1.	Asbestos-Forming Silicate Minerals	1-2
2.	Various Types of Friable and Non-Friable Asbestos Materials and Products (as of 1977)	1-5
3.	Major Facilities at the GDSCC	3-6
4.	Summary of Findings of Buildings Surveyed for Asbestos- Containing Materials at the GDSCC	5-3
5.	Results of Tests for Asbestos-Containing Materials in Roofs and Boilers at Specified Buildings at the GDSCC	5-6
6.	Asbestos-Containing Materials Found at the GDSCC	5-9
7.	Quantities of Asbestos-Containing Materials Found in Roofing and Boilers at Specified Buildings Surveyed at the GDSCC	5-10
8.	Condition of Asbestos at the GDSCC and Recommended Abatement Timing	5-13

9.	Condition of Asbestos in Roofs and Boilers at Specified Buildings at the GDSCC and Recommended Abatement Timing . . .	5-17
10.	Guidance for the Selection of the Suggested Timing for Asbestos-Abatement Procedures	5-19
11.	Chronology of Work Involved in Abatement/Removal of Friable Asbestos at the GDSCC	6-8
12.	Summary of Asbestos-Containing Materials Survey Information at the GDSCC	6-12

SECTION I

INTRODUCTION

A. STATEMENT OF PROBLEM

Large quantities of asbestos-containing materials commonly have been used at National Aeronautics and Space Administration (NASA) facilities both as insulation and materials of construction in buildings/structures constructed prior to 1978. It now is accepted, however, that inhalation and/or ingestion of airborne asbestos fibers poses a significant health hazard. As a result of these findings, many NASA facilities have implemented extensive asbestos-abatement programs as a preventive measure.

One of the NASA facilities involved in an asbestos-abatement program is the Goldstone Deep Space Communications Complex (GDSCC), which is described in Section III of this report. The GDSCC is managed, technically directed, and operated for NASA by the Jet Propulsion Laboratory (JPL) of the California Institute of Technology, Pasadena, California.

Federal, state, and local laws governing the management of asbestos, have become so complex that a need has been created to structure programs to comply with the many regulations implementing these laws. NASA, JPL, and the GDSCC, in supporting the national goal of preserving the environment and protecting human health and safety, have adopted a position that operating installations shall maintain a high level of compliance with these laws, based on a policy of prevention rather than reaction. Under supervision of JPL's Office of Telecommunications and Data Acquisition (TDA), efforts have been initiated at the GDSCC to develop and implement programs that focus on various environmental issues, including asbestos control and abatement.

B. THE NATURE OF ASBESTOS

The term "asbestos" does not refer to a single chemical substance, but is a common generic term given to a group of diverse, naturally occurring inorganic materials (silicate minerals). Under certain rare conditions, these minerals can crystallize abnormally into bundles of thousands of strong and flexible fibers that resemble fine threads. Asbestos, as a fibrous mineral, is mined and milled into numerous, commercially useful products.

Although the diverse asbestos minerals vary in their chemical compositions, they all show the following, commercially useful characteristics:

- (1) They do not burn (incombustibility).
- (2) They have high tensile strength.
- (3) They have high flexibility.
- (4) They provide good thermal and electrical insulation.
- (5) They have good noise absorption.
- (6) They are resistant to corrosive chemicals (acids, lyes, etc.).

All commercial varieties of asbestos are examples of minerals called silicates. These are minerals in which the backbone of the crystal lattice is formed by SiO_4 tetrahedra. The two groups of silicate minerals that give rise to the varieties of asbestos are known mineralogically as serpentines and amphiboles (Table 1).

C. ENVIRONMENTAL AND HEALTH PROBLEMS ASSOCIATED WITH ASBESTOS

1. History of Asbestos Use

Because it does not burn, asbestos has been used sporadically since the time of the ancient Greeks, more than 2,000 years ago. Some historical examples of the use of asbestos include a tablecloth woven from asbestos fibers for Charlemagne (8th century), a report by Marco Polo of the Chinese use of asbestos in gunpowder (13th century), and a purse owned by Benjamin Franklin that was woven with asbestos fibers (18th century).

Table 1. Asbestos-Forming Silicate Minerals

Silicate Mineral Name	Type of Asbestos	Common Name	Physical Characteristics	Usage in Commercial Application (%)	Where Mined
Serpentine	Chrysotile ^a	White Asbestos	Fine, flexible silky fibers with high tensile strength	90	Canada, USSR
Amphibole Group ^b					
Riebeckite	Crocidolite	Blue Asbestos	Brittle fibers	2-5	South Africa
Cumming-tonite-grunerite	Amosite ^c	Brown Asbestos	Brittle fibers that bond well with plastics	5-8	Transvaal, South Africa

^aMost widely used form of asbestos.

^bOther amphibole asbestos varieties, known as tremolite, actinolite, and anthophyllite, are rarely used in structures and commercial products.

^cThe name "amosite" is an acronym derived from the name of the company that mines it: Asbestos Mines of South Africa.

In modern times, the large-scale use of asbestos began about 1900 with the production of roofing coatings and with the manufacture of fire blankets. Since then, because of the unique properties of asbestos, more than 3,600 products that contain asbestos have been produced for commercial use in the United States. Some alphabetically listed examples of asbestos-containing materials that have been produced include acoustical ceiling tiles, asphalts, automobile brake linings, boiler insulation, cements, coatings for interior and exterior surfaces, fire-fighting equipment, floor tiles, mastics, millboard, pipes, pipe lagging, plasterboard, putties, roof shingles and tiles, ropes, spackles, theater curtains, wallpapers, and woven cloth and yarns. Thus, asbestos is nearly ubiquitous in public and industrial settings.

From the above, it may seem that asbestos-containing materials can be divided into the following two categories of products:

- (a) Category I: Textile products (woven cloth) and friable (easily crumbled or pulverized) materials. Friable asbestos materials, such as sprayed-on interior coatings in buildings, offices and schools, potentially can be dangerous, because by crumbling, pulverizing, or powdering, they can release asbestos fibers into the surrounding environment. The various ways asbestos fibers can be dispersed within a room with a sprayed-on, asbestos-containing ceiling material is depicted in Figure 1. Asbestos insulation found in boilers at the GDSCC typically is friable.
- (b) Category II: Matrix-bonded composite products that are hard and non-friable, including roof and floor tiles, cement pipes, and transite boards. These composites, in which the asbestos fibers have been tightly bound in a matrix of cement, organic resins, or other binding materials, normally do not create an asbestos-exposure hazard. If ground, sanded, or sawed, however, these composites can release asbestos fibers into the air. Asbestos in roofing materials at the GDSCC typically is non-friable.

A list of the more common types of friable and non-friable asbestos-containing materials in use in the United States is shown in Table 2.

About 70% of all asbestos usage in the United States has been in construction materials. The U.S. use of asbestos peaked in 1973 with a consumption of slightly more than 800,000 metric tons (about 880,000 U.S. short tons). Only 11 years later, because of reports pointing to the negative impact of asbestos on human health, the use of asbestos in 1984 fell 75% to only slightly more than 200,000 metric tons (221,000 U.S. short tons). The variety of manufactured asbestos-containing products has dropped from more than 3,600 different products to only about 500 today.

2. History of Asbestos-Caused Diseases

Both Strabo (a Greek geographer, 64 BC to AD 23) and Pliny the Elder (a Roman scholar, AD 23-79) described lung sickness among slaves who wove asbestos fibers into cloth. It was not until 1927, however, that this asbestos-caused lung sickness was formally recognized and given the name "asbestosis." Thus, just as the long-term inhalation of coal and rock dust

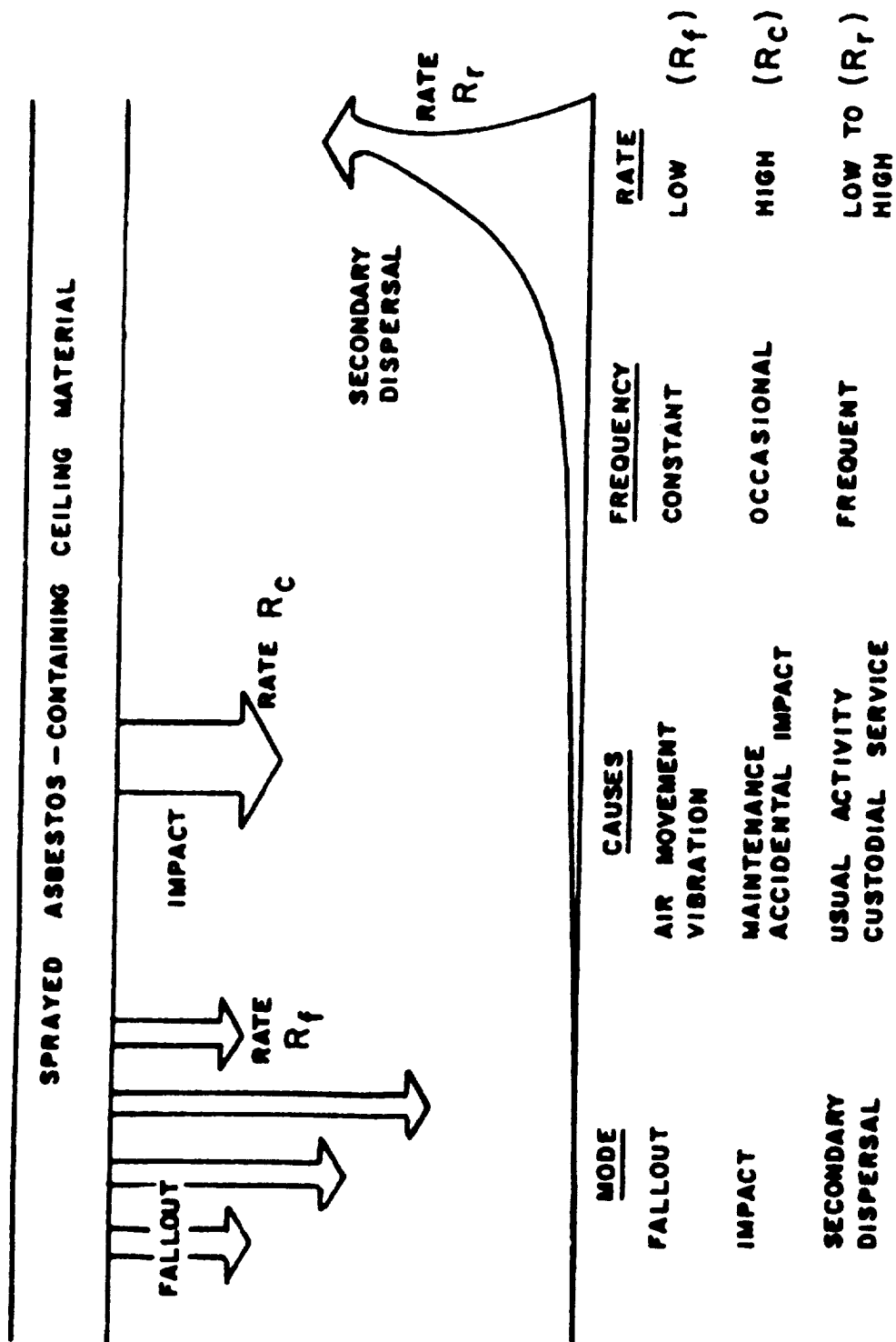


Figure 1. Modes and Rates of Asbestos Fiber Dispersal (Figure provided by National Asbestos Training Center, the University of Kansas, Lawrence, Kansas.)

Table 2. Various Types of Friable and Non-Friable Asbestos Materials and Products (as of 1977)^a

Subdivision	Generic Name	Asbestos Content (%)	Dates of Use in Commerce	Binder/Sizing
Friable insulation	spray-applied insulating material	1-95	1935-1970	sodium silicate, portland cement, organic binders
Preformed thermal insulating products	batts, blocks, and pipe covering			
	85% magnesia	15	1926-1949	magnesium carbonate
	calcium silicate	6-8	1949-1971	calcium silicate
Textiles	cloth ^b	100	1910-present	none
	blankets (fire) ^b	90-95	1920-present	cotton/wool
	felts:	80	1920-present	cotton
	blue stripe	90	1920-present	cotton
	red stripe	95	1920-present	cotton
	green stripe	50-95	1920-present	cotton/wool
	sheets	80-100	1920-present	cotton/wool
	cord/rope/yarn ^b	80-85	1920-present	cotton/wool
	tubing	90	1920-present	cotton/wool
	tape/stripe			
	curtains ^b	60-65	1945-present	cotton
	(theatre, welding)			

^aSource is U.S. Environmental Protection Agency, Guidance for Controlling Friable Asbestos-Containing Materials in Buildings, Office of Pesticides and Toxic Substances, EPA 560/5-83-002, March 1983, pp. C-2 and C-3.

^bLaboratory aprons, gloves, cord, rope, fire blankets, and curtains containing asbestos may be common in schools.

Table 2. (Cont'd)

Subdivision	Generic Name	Asbestos Content (%)	Dates of Use in Commerce	Binder/Sizing
Cementitious concrete-like products	extrusion panels:	8	1965-1977	portland cement
	corrugated	20-45	1930-present	portland cement
	flat	40-50	1930-present	portland cement
	flexible	30-50	1930-present	portland cement
	flex. perforated	30-50	1930-present	portland cement
	laminated	35-50	1930-present	portland cement
	(outer surface)			portland cement
	roof tiles	20-30	1930-present	portland cement
	clapboard and shingles:			
	clapboard	12-15	1944-1945	portland cement
Paper products	siding shingles	12-14	unknown-present	portland cement
	roofing shingles	20-32	unknown-present	portland cement
	pipe	20-15	1935-present	portland cement
	corrugated			
	high temperature	90	1935-present	sodium silicate
	moderate temp.	35-70	1910-present	starch
	indented	98	1935-present	cotton and organic binder
	millboard	80-85	1925-present	starch, lime, clay
	smooth surface	10-15	1910-present	asphalt
	mineral surface	10-15	1910-present	asphalt
Roofing felts	shingles	1	1971-1974	asphalt
	pipeline	10	1920-present	asphalt

Table 2. (Cont'd)

Subdivision	Generic Name	Asbestos Content (%)	Dates of Use in Commerce	Binder/Sizing
Asbestos-containing compounds	caulking putties	30	1930-present	linseed oil
	adhesive (cold applied)	5-25	1945-present	asphalt
	joint compound		1945-1975	asphalt
	roofing asphalt	5	unknown-present	asphalt
	mastics	5-25	1920-present	asphalt
	asphalt tile cement	13-25	1959-present	asphalt
	roof putty	10-25	unknown-present	asphalt
	plaster/stucco	2-10	unknown-present	portland cement
	spackles	3-5	1930-1975	starch, casein, synthetic resins
	sealants fire/water	50-55	1935-present	castor oil or polyisobutylene
Asbestos ebony products	cement, insulation	20-100	1900-1973	clay
	cement, finishing	55	1920-1973	clay
	cement, magnesia	15	1926-1950	magnesium carbonate
		50	1930-present	portland cement
	vinyl/asbestos tile	21	1950-present	polyvinylchloride
	asphalt/asbestos tile	26-33	1920-present	asphalt
	sheet goods/resilient	30	1950-present	dry oils
	vinyl wallpaper	6-8	unknown-present	---
	roof coating	4-7	1900-present	asphalt
	air tight	15	1940-present	asphalt

gives rise to a disease called silicosis (black lung) in coal miners, the long-term inhalation of asbestos fibers irritates the lungs and leads to asbestosis among asbestos workers.

The relationship between asbestos and disease became more complex in 1949, when a medical report was published that linked asbestosis with lung cancer. The report pointed out that there was a greater incidence of lung cancers proportionately among patients with asbestosis than among the general population.

Nor was this all. In the 1960s, studies among asbestos workers in South Africa showed a great increase in the number of patients with mesothelioma, a previously extremely rare form of cancer. Almost exclusively, mesothelioma victims were shown to be individuals who had been exposed to asbestos 30 to 40 years before the cancer's symptoms had become evident. There is a long latent period between exposure to asbestos and the manifestation of clinical symptoms of mesothelioma. Steve McQueen, the well-known actor, was a victim of mesothelioma.

Thus, asbestos now is known to be involved in three major diseases: asbestosis, lung cancer, and mesothelioma. Since asbestos fibers can scar lung tissue, and cigarette smoke interferes with the normal function of lung tissue, it is not surprising that individuals who have been exposed to high concentrations of asbestos and who also smoke are about 50 times more likely to develop lung cancer than is a non-smoker exposed to ambient low-level concentrations of asbestos. The incidence of lung cancer in workers exposed to asbestos would be markedly reduced if the workers did not smoke cigarettes.

Asbestos workers are not the only population at risk. Greater than normal numbers of malignancies have been found in persons living and working in proximity to asbestos manufacturing facilities and in households of asbestos workers.

D. GENERAL CHARACTERISTICS OF ASBESTOS-CAUSED DISEASES

The unique properties of asbestos that enhance its commercial usefulness are the same properties that make it hazardous to humans.

Asbestos fibers are hazardous to health when breathed into the lungs because of the following three properties:

- (1) Asbestos fibers can splinter into smaller and smaller fibrils until they become so tiny that they only can be detected with optical and electron microscopes. The fibers can become smaller than red blood cells or bacteria and can easily penetrate through the nasal passages into the lungs.
- (2) Because of their microscopically small size, asbestos fibers can remain suspended in air for hours or days after any disturbance (sweeping, dusting, etc.) has resulted in recirculation of previously settled and accumulated fibers back into the air.
- (3) Because of their chemical inertness and physical aspect ratio (much longer than their diameters), asbestos fibers are resistant to efforts by the body's immune system to remove them from the body.

1. Inhalation and Ingestion of Asbestos Fibers

The breathing in (inhalation) of asbestos fibers now is definitely linked to the development of three diseases: asbestosis, lung cancer, and mesothelioma. At present, there is no definite evidence that asbestos fibers that are ingested through food and drinking water are responsible for cancers of the mouth, larynx, esophagus, stomach or the gastrointestinal tract. This is a matter of concern, however, because since 1930, about 200,000 miles of asbestos cement pipes have been installed in the United States for the transmission and distribution of drinking water supplies. During their lifetimes, some Americans ingest far more asbestos fibers in their drinking water than they inhale.

Once asbestos fibers are inhaled, they can become embedded in lung tissue where they remain, presumably, for the lifetime of an individual. The greater the concentration of asbestos to which the individual has been exposed, the greater the risk of developing an asbestos-caused disease.

2. Relationship Between Type of Asbestos Fibers and Disease

All types of asbestos, whether the serpentine mineral (chrysotile) or the amphibole minerals (amosite or crocidolite) can cause disease. There is controversial evidence that indicates that chrysotile, the most commonly used form of asbestos, may be less involved in the development of mesothelioma than are the amphibole minerals. Chrysotile, however, is just as potent as the amphiboles in causing lung cancer, a much more common form of cancer than mesothelioma.

3. Theories as to How Asbestos Fibers Cause Disease

At present, although there are numerous theories and speculations, it is not known how asbestos causes disease. Some researchers claim that the deleterious effects of asbestos fibers are due to the physical nature of the asbestos fibers rather than to their chemical composition. The size of the fibers seems to be important. The aspect ratio of a fiber (ratio of a fiber's length to its diameter) may play a key role. Thus, it has been reported in experiments with rats that particular fibers, less than 0.25 μm in diameter and longer than 8 μm , were closely connected to the development of mesothelioma.

If it is true that the harmful effects of asbestos arise because the fibers act as slender, microscopically small "arrows," then fibers that have been proposed as substitutes for asbestos (borosilicate glass, potassium titanate, silicon carbide, zeolites and some aluminum compounds) also should give rise to mesotheliomas if their fibers also have high aspect ratios. There are some experiments to indicate that this, indeed, is the case.

Other researchers claim that asbestos fibers exert their harmful effects because their specific chemical compositions alter the surface chemistry of cell membranes. This suggests that, if asbestos minerals could be modified chemically, they may become "safe fibers" and no longer be harmful. This concept now is under experimental investigation.

E. ASBESTOS-CAUSED DISEASES

1. Asbestosis

Asbestosis usually results after exposure to high concentrations of asbestos fibers over a long period of time (15 to 35 years). The lungs become scarred as a result of the body's reaction to the asbestos fibers embedded in the lung tissue. The disease is progressive and continues to worsen even after the victim no longer is exposed to asbestos. Asbestos victims are at high risk to develop lung cancer.

The Environmental Protection Agency (EPA) has compiled information revealing that the risk of asbestosis is negligible at exposure levels below those allowed for asbestos workers. Some scarring of lung tissue may appear on X-rays after many years of low exposure, but no impairment of respiratory function is likely to occur.

2. Lung Cancer

Lung cancer accounts for more than half of the deaths of individuals who have been exposed to asbestos. Most asbestos-caused lung cancers become manifest after age 45. Smoking increases the risk. A 1-pack/day cigarette smoker exposed to asbestos increases by 50-fold his risk of getting lung cancer as compared with a nonsmoker. By smoking 2 to 3 packs/day, a cigarette smoker increases the risk to 90-fold that of a nonsmoker. Asbestos workers are not the only population at risk. Excess malignancies have been found in persons living and working in proximity to asbestos-manufacturing facilities and also in households of asbestos workers.

3. Mesothelioma

Mesothelioma is a cancer of the tissues that line either the lung (pleural mesothelioma) or the abdomen (peritoneal mesothelioma). It is an extremely rare form of cancer in individuals who have not been exposed to asbestos. The cancer has a long latency period of 25 to 40 years, between exposure to asbestos and the appearance of symptoms. There is no cure for mesothelioma, and victims usually die within a year after the disease is diagnosed. There is no apparent relationship between smoking and mesothelioma, as there is between smoking and lung cancer, for asbestos-exposed individuals.

In contrast to the EPA's finding that the risk of asbestosis is negligible at exposure levels below those allowed for asbestos workers, the incidence of lung cancer and mesothelioma exceeds baseline rates even at very low exposure levels. This conclusion is supported by the increased incidence of lung cancer for workers experiencing the equivalent of five year's exposure to airborne asbestos at the current Federal workplace standard. In addition, mesothelioma has been found in persons whose only known exposure to asbestos was from living in a household with asbestos workers or living in the neighborhood of asbestos mines, mills, or processing facilities.

4. Gastrointestinal Cancers

Medical data also indicate an increased incidence of cancers of the stomach and intestinal tract (gastrointestinal cancers) among asbestos workers as compared with individuals not exposed to asbestos. This suggests that these esophagus, stomach, colon and other cancers may arise from ingestion of asbestos fibers in food and drink. At present, although there is no strong medical evidence to support this suggestion, some research is under way to investigate this possible relationship. The EPA now is considering whether to set a standard for asbestos fiber concentrations in drinking water as it has done for asbestos fiber concentrations in air.

5. Potential Health Risk as a Function of Airborne Asbestos Levels and Exposed Population Exposure

It now is believed that any level of exposure to airborne asbestos involves some health risk, although the exact degree of risk cannot be reliably estimated. The risk of cancer is of greater concern at low exposure levels than the risk of asbestosis. The presence of asbestos-containing materials in the work environment represents a potential for exposure and risk of asbestos-related disease that cannot be ignored. The decision whether to remove asbestos is a management decision that must be balanced against the risks.

SECTION II

REGULATIONS THAT GOVERN MANAGEMENT OF ASBESTOS

A. INTRODUCTION

The Environmental Protection Agency (EPA), the Federal Occupational Safety and Health Administration (OSHA), and the California Department of Industrial Relations, Division of Occupational Safety and Health (DOSH) regulate the use, handling, and disposal of asbestos-containing materials. The EPA regulations are directed toward:

- (1) Application of asbestos-containing materials in both new and remodeled buildings.
- (2) Identification and removal of asbestos in schools.
- (3) Regulation of air emissions generated from handling asbestos-containing materials.
- (4) Regulation of disposal of asbestos-containing materials.

Workplace safety and worker protection are regulated by Federal OSHA. Individual states, however, may operate their own OSHA programs. California operated its own Federally approved OSHA program (Cal/OSHA) until July 1, 1987. At that time, Cal/OSHA lost funding until a California State Appeals Court unanimously ruled to reinstate the program in October 1987.

When the program was terminated in July 1987, the standards of the Cal/OSHA program substantially were the same as the Federal OSHA standards. The primary difference was Cal/OSHA's requirement for the registration of carcinogen users. Carcinogen user registration now must be reported to the California Division of Occupational Safety and Health (DOSH).

In addition to the above EPA and OSHA environmental requirements, NASA has issued its own technical bulletins, guidelines, and memoranda. In the past, NASA guidelines have been more stringent than some of the Federal guidelines. It is anticipated that the OSHA, EPA and NASA guidelines for the management of asbestos will become even more stringent in future years.

B. FEDERAL REGULATIONS

In 1973, EPA, under the Clean Air Act, National Emission Standards for Hazardous Air Pollutants (NESHAPS), began issuing bans on the application of asbestos-containing materials in buildings. By 1978, the ban included

asbestos-containing spray-applied insulation (SAI) for insulation and fire-proofing purposes, and spray-applied decorative materials (decorative textured ceiling applied to gypsum board). These regulations are found in 40 Code of Federal Regulations (CFR), parts 61.145 through 61.147. As of 1988, there were no bans on the use of asbestos-containing materials in roofs and boilers.

The regulations are designed to prevent emissions to the outside air as a result of demolition and renovation activities. Notification requirements and emission control criteria are stipulated in the regulations. Packaging, labeling and disposal of waste asbestos also are addressed.

In 1972, Federal OSHA began issuing asbestos-related regulations designed to protect the worker and workplace from asbestos exposure. The standards, which are found in 29 CFR 1910 and 29 CFR 1926, address reporting requirements, airborne exposure concentrations for asbestos workers, engineering and administrative controls, workplace practices, medical surveillance, and worker protection requirements.

Prior to July 21, 1986, the permissible exposure limit (PEL) for asbestos fibers was 2.0 fibers per cubic centimeter (f/cc) for fibers greater than five micrometers in length. The 2.0 f/cc-standard was a time-weighted average (TWA) for an 8-hour work day, 40-hour work week. In addition to the PEL, a ceiling limit of 10 f/cc and an action limit of 0.2 f/cc were established. On July 21, 1986, a new standard became effective that reduces the PEL to 0.2 f/cc TWA, the ceiling limit to 2.0 f/cc, and the action limit to 0.1 f/cc. The new standard also distinguishes between general industry and construction requirements. Under OSHA requirements, states must adopt rules at least as stringent as the Federal requirements within six months of promulgation of the Federal rules. This means that California is presently subject to the new Federal OSHA standards.

C. CALIFORNIA REGULATIONS

1. Water Quality Requirements: Lahontan Regional Water Quality Control Board

The GDSCC is under the jurisdiction of the Lahontan Regional Water Quality Control Board (LRWQCB). The LRWQCB enforces regulations to protect the waters of the state of California under the California Administrative Code (CAC), Title 23, Subchapter 15. At this time, the regional board does not have a limit for discharge of asbestos to ground or surface waters. If demolition or abatement activities take place at the GDSCC, care should be taken to prohibit fibers from entering septic tanks or pond systems. This could be construed to constitute disposal of a hazardous waste, even though the regional board has not set discharge limits.

An extension of the water quality requirements are the reporting requirements found in the Safe Drinking Water and Toxic Enforcement Act of 1986 (The California Administrative Code, Title 26, Chapter 6.6). By 1988, persons responsible for the release or threatened release of asbestos into the drinking water supply will be required to report such releases to agencies and the affected community. At the present time, Federal facilities are not subject to Title 26, Chapter 6-6. There is activity in the state legislature, however, to eliminate this exemption.

2. Air Quality Requirements: San Bernardino Air Pollution Control District (SBAPCD)

The GDSCC is under the jurisdiction of the San Bernardino Air Pollution Control District (SBAPCD). The District's Rule 1002 - Emission Standard for Asbestos is substantially the same as the Federal NESHAPS requirements. EPA has given local air pollution control agencies primary authority to enforce asbestos and other air pollution regulations. In states with their own programs, however, notifications must be made to the local agency as well as the EPA.

3. Hazardous Waste Requirements: California Department of Health Services

The California Department of Health Services (DHS) has classified asbestos-containing material as a hazardous waste, if the percent by weight of asbestos exceeds one percent. This is stipulated in the CAC, Title 22, Chapter 30, Articles 9 and 11. All other requirements for the handling and disposal of a hazardous waste under Title 22 also apply to asbestos. Current guidance from the DHS on the disposal of asbestos is as follows:

- (1) The contractor or owner (preferably the owner), as a generator of asbestos waste, must obtain an EPA Generator's Identification Number.
- (2) The asbestos-containing material may be disposed of at either a Class I or a designated Class II landfill.

Because asbestos is a hazardous waste, it must be packaged, labeled, marked, and transported in accordance with the Federal Department of Transportation regulations found in 49 CFR 172, in addition to any regulations from CAC, Title 22.

4. California OSHA

Cal/OSHA regulations on asbestos are found in CAC, Title 8, Section 5208. The state regulations were as stringent as the Federal OSHA regulations until the July 21, 1986, Federal amendments were promulgated. These amendments reduced the PEL from 2.0 f/cc to 0.2 f/cc. Recently, California issued a proposed rule to reduce the PEL from the current standard of 2.0 f/cc to 0.1 f/cc. The proposed ruling did not pass. It was greatly opposed by industry as being a standard too difficult, if not impossible to meet. As a result, California technically is subject to the Federal rule until it adopts a PEL that is at least as stringent as the Federal PEL.

Cal/OSHA standards are substantially the same as Federal standards (except as discussed above). Because Cal/OSHA has been given primary authority for enforcing asbestos and other health and safety regulations, notifications are made directly to Cal/OSHA. Because asbestos regulations, notifications are changing so rapidly, it is recommended that both the Federal and state OSHA requirements be monitored regularly to prepare for anticipated stricter standards.

5. Local Requirements: Roofing

The GDSCC is under the jurisdiction of the San Bernardino County Building Code enforced by the San Bernardino County Office of Building and Safety. The building code has requirements on the number and type of roll-composite roofs allowed to be applied over an existing roof (Building Code, Chapter 32 Section 3[d][2] and its Appendix). This section of the building code is extremely complex, with a number of exceptions of the rule. The rule in its simplest form allows for one application of roofing on a structure. The criteria that allow more than one application of roll-composite roofing are stringent and are difficult to fulfill.

D. NASA GUIDANCE

On February 18, 1983, the NASA Occupational Health Office, in conjunction with the Facilities Division, issued guidelines for asbestos hazard-assessment and abatement (see Appendix B). The guidelines apply primarily to spray-applied insulation (SAI) and are scheduled to be updated. The updated version is anticipated to parallel the Federal OSHA regulations and EPA guidelines. The NASA Occupational Health Office has recently told M. B. Gilbert Associates (MBGA) that permissible asbestos exposure levels established by NASA would most likely be equivalent to the current Federal OSHA levels.

E. SUMMARY OF ASBESTOS REGULATIONS

Federal OSHA and NESHAPS asbestos rules have been designed to protect those persons who remove asbestos from buildings and who live near or work in the asbestos industry. The rules also include standards to reduce exposure to airborne asbestos. There are no existing Federal rules that directly address the protection from exposure of persons occupying buildings. Review of these rules shows that they address outdoor air levels, with no application to indoor levels.

The EPA, on the other hand, under the Toxic Substances Control Act (TSCA) has begun to address the problem of indoor asbestos levels by issuing its rules on identification of asbestos in schools. It also has issued its restrictions on the application of asbestos-containing materials in new or remodeled buildings (under NESHAPS, as authorized in the Clean Air Act). In addition, EPA has issued rules on the emission of asbestos fibers from the handling of asbestos in the asbestos industry and the disposal of asbestos-containing waste.

Additional bans related to asbestos mining and manufacturing are anticipated to be promulgated by EPA. It also is anticipated that certain uses of asbestos will be banned, and perhaps removal of specified asbestos products will be required as well. One area to consider is any future installation of new transite piping. New rules could be issued to prohibit both the installation of new transite water piping and the continued use of existing transite water piping. If this should occur, facilities could be required to discontinue use of old pipes and lay new pipes that do not contain asbestos.

A bibliography of pertinent regulatory documents dealing with asbestos is presented in Appendix E.

SECTION III

THE GOLDSTONE DEEP SPACE COMMUNICATIONS COMPLEX (GDSCC)

A. LOCATION OF THE GDSCC

The Goldstone Deep Space Communications Complex (GDSCC) is located in southern California, in a natural, bowl-shaped depression in the Mojave Desert, in San Bernardino County about 40 miles north of Barstow, California, and about 160 miles northeast of Pasadena, California, where the Jet Propulsion Laboratory (JPL) is located.

As indicated in Section I, the GDSCC is part of the National Aeronautics and Space Administration's (NASA's) Deep Space Network (DSN), one of the world's largest and most sensitive scientific telecommunications and radio navigation networks. The Goldstone Complex is managed, technically directed, and operated for NASA by the Jet Propulsion Laboratory of the California Institute of Technology in Pasadena, California.

The 52-mi² Goldstone Complex lies within the western part of the Fort Irwin Military Reservation (Figure 2). A Use Permit for the land was granted to NASA by the U.S. Army. The Complex is bordered by the Fort Irwin Military Reservation on the north, east and southeast; the China Lake U.S. Naval Weapons Center on the northwest; and state and Federal lands managed by the U.S. Bureau of Land Management (BLM) on the south.

B. FUNCTIONS OF THE GDSCC

After the Space Act of 1958 had accelerated U.S. plans and programs for space exploration, JPL initiated construction work at Goldstone to build the first tracking station of what is now known as the Deep Space Network (DSN). Thus, for more than three decades, the primary purpose of the DSN has been and continues today to support the tracking of both manned and unmanned spacecraft missions and to provide instrumentation for radio and radar astronomy in the exploration of the solar system and the universe.

Over the years, the DSN has become a world leader in the development of low-noise receivers; tracking, telemetry, and command systems; digital signal processing; and deep space radio navigation.

The basic responsibilities of the DSN are to receive telemetry signals from spacecraft, to transmit commands that control the various spacecraft operations, and to generate the radio navigation data used to locate and guide the spacecraft to its destination.

Because of its advanced technical ability to perform the above services, the DSN also is able to carry out the following functions: flight radio-science, radio and radar astronomy, very long baseline interferometry (VLBI), precise measurement of minute earth movements (geodynamics), and participation in the NASA Search for Extraterrestrial Intelligence (SETI).

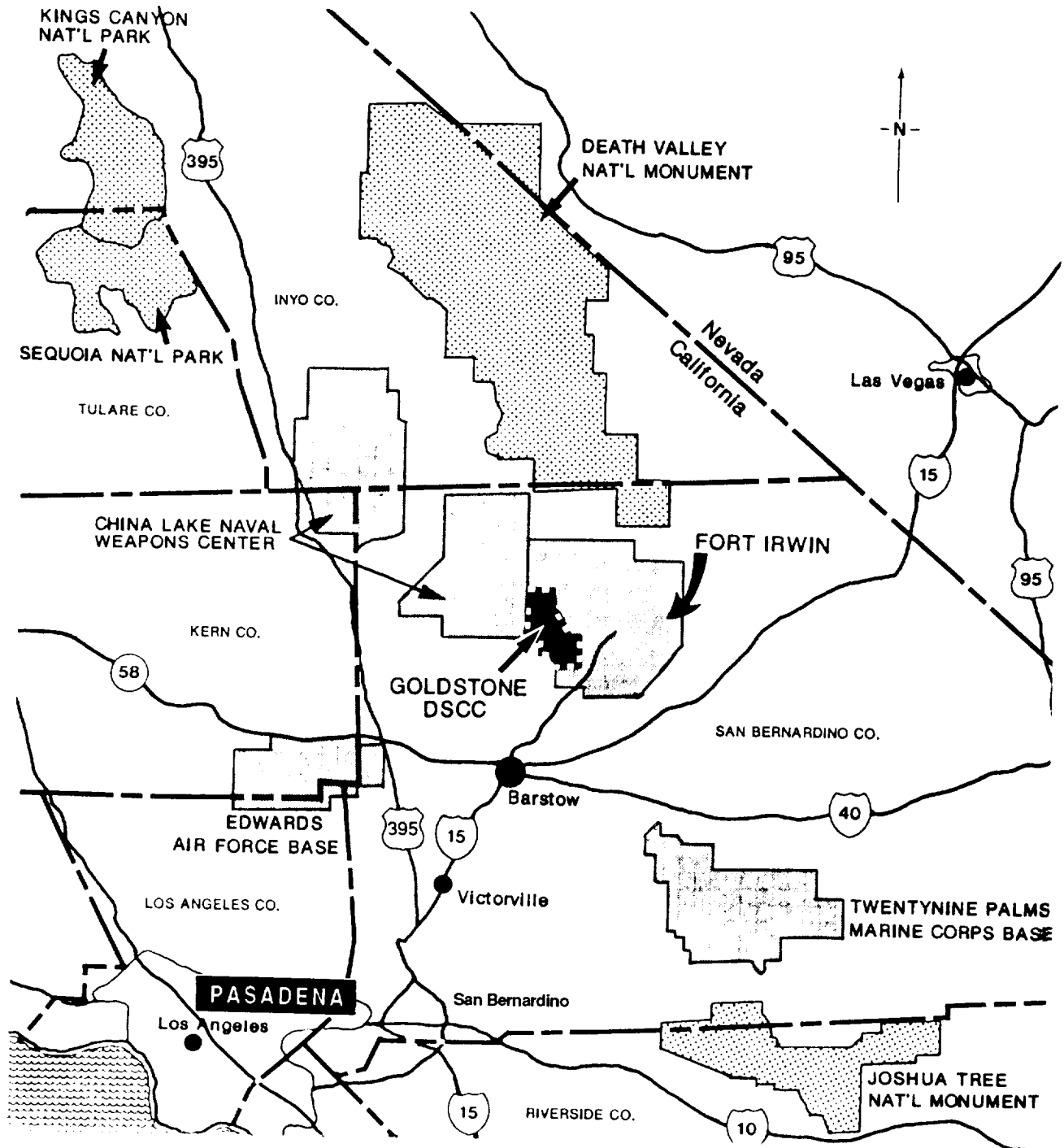


Figure 2. Geographic Relationship of the Goldstone Deep Space Communications Complex to JPL in Pasadena

Goldstone also is a research and development center to extend the communication range and to increase the data acquisition capabilities of the DSN. It serves as a proving ground for new operational techniques. Prototypes of all new equipment are thoroughly tested at Goldstone before they are duplicated for installation at overseas stations (see Section III, C below).

C. FACILITIES AT THE GDSCC

The GDSCC is a self-sufficient, working community with its own roads, airstrip, cafeteria, electrical power, and telephone systems, and it is equipped to conduct all necessary maintenance, repairs, and domestic support services. Facilities at the GDSCC include about 100 buildings and structures that were constructed during a 30-year period from the 1950s through the 1980s. The construction of additional buildings and structures continues today as the GDSCC increases its activities and operations.

Goldstone is one of three Deep Space Communications Complexes (DSCCs) operated by NASA that are located on three continents: at Goldstone in southern California's Mojave Desert; in Spain, about 60 kilometers (37 miles) west of Madrid at Robledo de Chavela; and near the Tidbinbilla Nature Reserve, in Australia, about 40 kilometers (25 miles) southwest of Canberra. Because these three DSCCs are approximately 120 degrees apart in longitude, a spacecraft is nearly always in view of one of the DSCCs as the Earth rotates on its axis (Figure 3).

Activities at the GDSCC operate in support of six parabolic dish antennas, at five sites called Deep Space Stations (DSSs): Four sites are operational, while one is devoted to research and development (R&D) activities. There also are four, similar, operational DSSs in Spain and in Australia. Thus, the NASA DSN consists of a worldwide network of 12 operational DSSs. There are three antennas at the Venus Site (for research and development), while another parabolic dish antenna at Goldstone is operated by the National Oceanic and Atmospheric Administration (NOAA).

A Network Operations Control Center (NOCC), located at JPL in Pasadena, controls and monitors the DSN. A Ground Communications Facility (GCF) of the DSN operates to link together the NOCC at JPL with the three DSCCs at Goldstone, Spain, and Australia.

Total NASA/JPL facilities at the GDSCC (Figure 4) include the six DSN parabolic dish antennas, an airport, a microwave test facility, miscellaneous support buildings, and a remote support facility in Barstow located about 40 miles south of the GDSCC. The GDSCC support staff consists of about 260 personnel on-site and at the Barstow facility. Table 3 summarizes the major facilities, buildings (number and square footage), and antennas (construction date and size). Three sites within the GDSCC have antennas (referred to as stations) devoted to NASA DSN operations: Echo Station, Mars Station, Uranus Station, and two antennas at Apollo Station. Two other sites have antennas devoted to research and development: Venus, operated by the GDSCC, and Mojave, operated by the National Oceanic and Atmospheric Administration.

A 26-meter (85-ft) antenna, located at the Pioneer Site, was deactivated in 1981. In 1985, the Pioneer antenna (DSS-11) was designated a National Historic Landmark by the U.S. Department of Interior, and the Pioneer Site was returned to the U.S. Army. Each of the Goldstone sites is briefly described below.

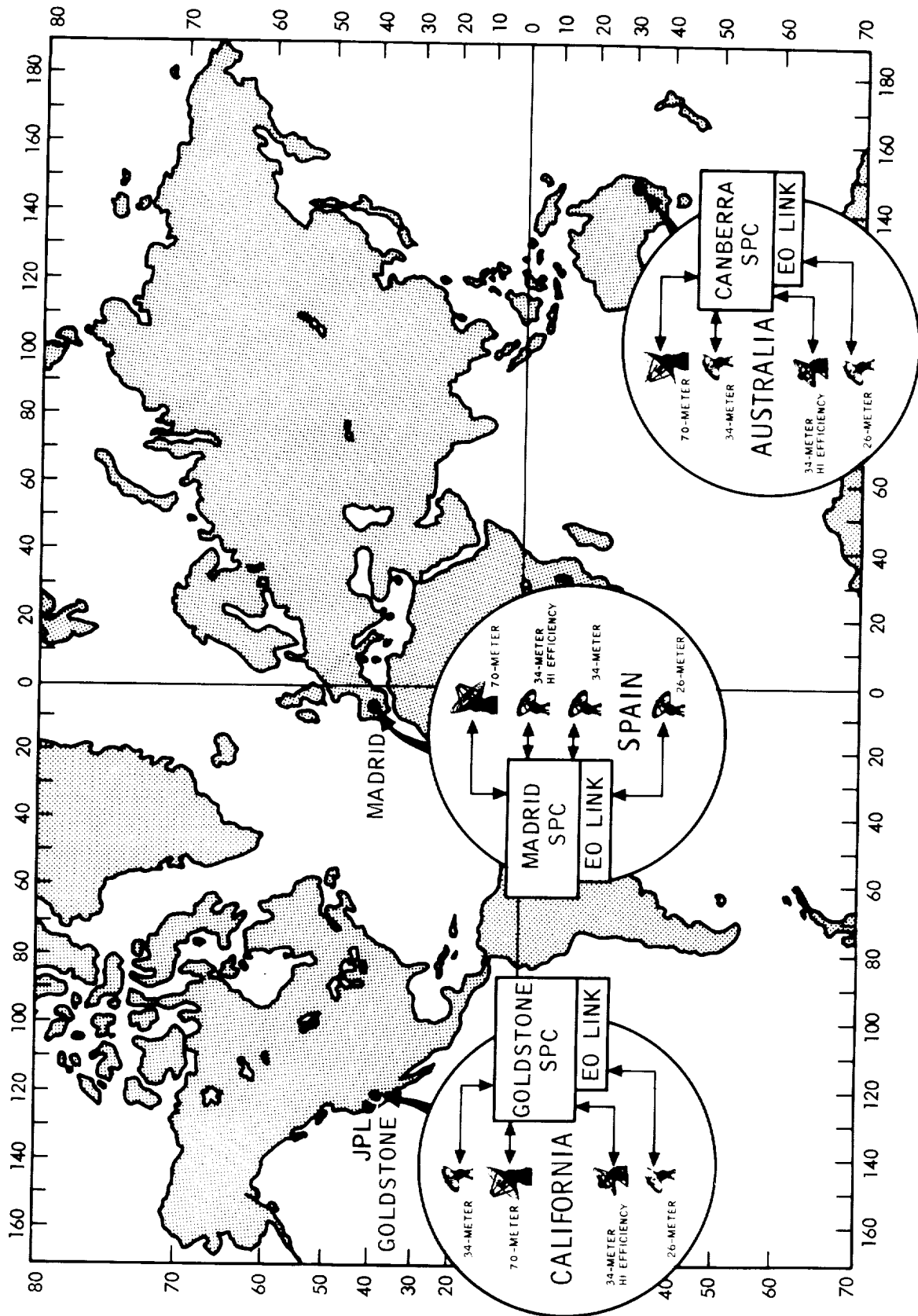


Figure 3. The Three-Continent NASA Deep Space Network as It Exists in 1990

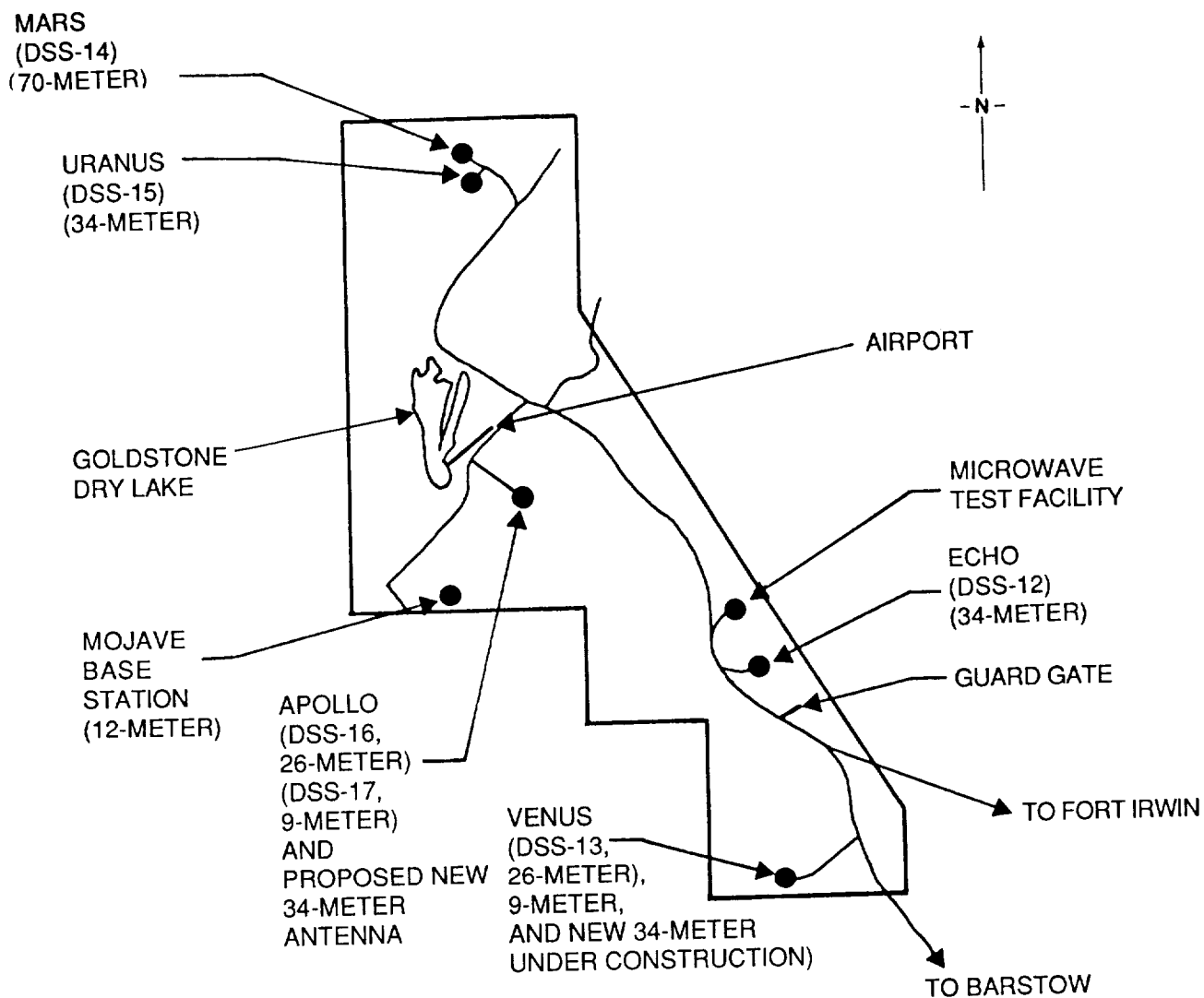


Figure 4. Schematic Map of the Goldstone DSCC Showing Locations of the Five NASA Deep Space Stations (DSSs) and the Mojave Base Station Operated by NOAA

Table 3. Major Facilities at the GDSCC

Site	Station Number	Buildings		Antennas	
		Number	(ft ²)	Date of Construction	Size (Meters)
Echo Site	DSS-12	25	79,208	1961 ^a	34 ^b
Venus Site	DSS-13	15	12,589 ^c	1962 ^d	26
	(present antenna)				9
	DSS-13 (now under construction)				34
Mars Site	DSS-14	14	41,754	1966	70 ^e
	DSS-15			1984	34
Apollo Site	DSS-16	21	43,978	1965 ^f	26
	DSS-17				9
	DSS-18 (proposed)				34
Mojave Site		5	11,850	1964	12 ^g
Airport ^h		3	4,848	1963/1970	--
Microwave Test Facility	MTF	1	2,880	1963	--
Miscellaneous	--	3	1,430	--	--
Barstow Facility ⁱ		1	28,343	--	--

^aThe original antenna, built in 1959, was moved to the Venus Site in 1962. A 26-meter antenna, built in 1961, was extended to 34 meters in 1978.

^bThis antenna is to be dismantled and removed after the DSS-18 antenna at the Apollo Site becomes operational in 1993.

^cThis square footage does not include the two newly constructed facilities for Hazardous Materials Storage and for Acid-Wash.

^dThis antenna was constructed at the Echo Site in 1959 and moved to the Venus Site in 1962.

^eOriginally constructed as a 64-meter antenna in 1966, this antenna was enlarged to 70 meters in 1988.

^fThis antenna originally was constructed for the NASA Goddard Space Tracking and Data Network. JPL/GDSCC/DSN operation of the antenna began in October 1984.

^gThis antenna is operated by the National Oceanic and Atmospheric Administration (NOAA).

^hThe airport is located at the Goldstone Dry Lake.

ⁱThis site, a leased facility, is located in Barstow, California, about 40 miles southwest of the GDSCC.

Source: Directory of Goldstone DSCC Buildings and Supporting Facilities (Gold Book, Document 890-165, JPL internal document), Jet Propulsion Laboratory and National Aeronautics and Space Administration, Revised Edition, October 1989.

D. ANTENNA STATIONS AT THE GDSCC

1. Echo Site (DSS-12)

The Echo Site, as the administration center and operations headquarters of the GDSCC, is the most extensively developed site on the complex. It has one 34-meter (111.5-ft) antenna and 24 support buildings, with a combined area of 79,208 ft². Support buildings include administration and engineering offices, cafeteria, dormitory, transportation and maintenance facilities, storage areas, and warehouses. The Echo Station originally was built in 1959 as a 26-meter (85-ft) antenna. The antenna was first used in 1960 to support the Echo Project, an experiment to transmit voice communications coast-to-coast by bouncing radio signals off the reflective Mylar surface of a passive balloon-type satellite. In 1962, this original 26-meter antenna was moved to the Venus Site. In anticipation of this move, a newer 26-meter antenna had been built at the Echo Site in 1961. In 1978, this antenna was enlarged to 34 meters (111.5 ft). The present antenna is approximately 35 meters (113 ft) high and weighs about 270,000 kilograms (300 tons). In 1993, it is to be replaced by the new DSS-18 34-meter antenna that is proposed to be constructed at the Apollo Site.

2. Venus Site (DSS-13)

The Venus Site consists of two antennas: a 26-meter (85-ft) antenna and a 9-meter (29.5-ft) antenna. The smaller antenna is no longer used. There are 15 buildings having a combined area of 12,589 ft². The support buildings provide space for operations control, laboratories, offices, security, workshops, warehouses, and mechanical equipment. The 26-meter antenna, which was originally located at the Echo Site, was moved to the Venus Site in 1962. The antenna was used for a radar astronomy study of the planet Venus. Currently, its primary functions are research and development and performance- and reliability-testing of high-power radio-frequency transmitters and new systems and equipment prior to their introduction into the Deep Space Network.

A new 34-meter (111.5-ft) antenna is now under construction to replace the 26-meter antenna. The new DSS-13 antenna is planned to begin research and development activities in 1991. An Environmental Assessment concerning this new antenna is the subject of JPL Publication 87-4, Volume 6, Environmental Assessment: New 34-Meter Antenna at Venus Site (June 15, 1988).

3. Mars Site (DSS-14 and DSS-15)

The Mars Site consists of two antennas and 14 buildings, with a combined area of 41,754 ft². The support buildings provide facilities for operations control, offices, training, mechanical equipment, storage, and security. In May 1989, M. B. Gilbert Associates (MBGA), Long Beach, California, submitted an Environmental Assessment to JPL concerning the construction work needed for a proposed building extension to the Operations Building (Bldg. G-86) at the Mars Site.

JPL Publication 87-4, Volume 11, Environmental Assessment: Addition to Operations Building, Mars Site (February 15, 1990), is an expanded JPL-version of the EA document submitted to JPL by MBGA in May 1989.

The Mars Station Antenna (DSS-14), at 70 meters (230 ft) in diameter, is one of the larger antennas of its kind in the world (see Front Cover). The antenna, which was constructed as a 64-meter antenna in 1966 and enlarged to 70 meters in 1988, is 7.25 times more powerful and sensitive than a 26-meter antenna, extending the range of deep space communications by 2.7 times. It can maintain communications with spacecraft to the edge of the solar system. Standing more than 235 ft high, this antenna is one of the more striking features to be seen in the GDSCC geographic area. The 70-meter antenna was used in August 1989 for the Voyager 2 spacecraft's encounter with the planet Neptune. The latter is located at a distance of 4.5 billion kilometers (2.8 billion miles) from Earth.

The Uranus Station Antenna (DSS-15) is a 34-meter, high-efficiency (HEF), precision-shaped antenna, located approximately 1,600 ft southeast of the Mars Station Antenna. Built in 1984, this latest antenna at the GDSCC first was used in January 1986 to support the encounter of the Voyager 2 spacecraft with the planet Uranus, located at a distance of more than 3 billion kilometers (1.8 billion miles) from Earth. The new, proposed 34-meter, precision-shaped antennas, now under construction at the Venus Site (see above) and proposed for the Apollo Site (see below), are similar in size and structure to this Uranus Station antenna.

4. Apollo Site (DSS-16, DSS-17 and DSS-18)

The Apollo Site has a 26-meter (85-ft) antenna (DSS-16), a 9-meter (29.5-ft) antenna (DSS-17), and 21 buildings, with a combined total area of 43,978 ft². The buildings provide space for operations, equipment, storage, and warehousing. The 26-meter antenna originally was constructed in 1965 by NASA's Goddard Space Tracking and Data Network to support the manned Apollo missions to the moon. Operation of this antenna under JPL management began in October 1984. Both the 26-meter and the 9-meter antennas now are used to support the missions of the Space Shuttle (STS) and satellites in both low and high Earth orbits. In May 1989, M. B. Gilbert Associates, Long Beach, California, submitted an Environmental Assessment to JPL concerning the construction work needed for a proposed new 34-meter (111.5-ft) antenna (DSS-18) at the Apollo Site. The details of this Environmental Assessment are described in JPL Publication 87-4, Volume 10, Environmental Assessment: New 34-Meter Antenna at Apollo Site (January 15, 1990).

5. Mojave Base Site (NOAA Antenna)

The Mojave Base Site has one antenna and five buildings, with a combined area of 11,850 ft². At one time, these buildings provided support facilities for operations, equipment, and maintenance. Except for the National Oceanic and Atmospheric Administration (NOAA) operations buildings, however, these buildings now are not in use.

The Mojave Base Site Antenna is a 12-meter (40-ft) antenna operated by NOAA. The antenna is involved in several programs, including monitoring of shifts in the Earth's tectonic plates, monitoring weather changes, and retrieving information from very low-orbiting Earth satellites.

E. SUPPORT FACILITIES AT THE GDSCC

1. Goldstone Dry Lake Airport

The airport consists of an approximately 6,000- by 100-ft paved runway. There are two buildings at the airport site, neither of which is presently in use. An open hangar is used to provide shelter for a single aircraft. For its personnel, NASA operates three scheduled shuttle flights per week to the GDSCC that originate from the Burbank-Glendale-Pasadena Airport. In addition, the Goldstone airport is used infrequently by administrative Army flights. Both NASA and the U.S. Army use propeller-driven aircraft.

2. Microwave Test Facility and Fire-Training Area

The Microwave Test Facility (MTF) and Fire-Training Area consist of a single building of 2,880 ft² along with areas identified for fire fighting. The MTF is used for research and development testing of antenna microwave equipment. Fire training includes procedures for the quenching of fires.

3. Miscellaneous Buildings in the GDSCC Area

Three buildings and structures at the GDSCC that fall into this category include the main gatehouse, pump house, and radio spectrum monitor. The total area of these three buildings/structures is 1,430 ft².

4. Off-Site Facility at Barstow, California

In addition to the above-mentioned on-site facilities, the GDSCC leases an office and warehouse support facility in the nearby city of Barstow. The facility is a single-story, 28,343-ft² structure located at 850 Main Street.

F. NON-STRUCTURAL SUPPORT FACILITIES AT THE GDSCC

1. Transportation Network

The major roadways in the area are shown in Figure 5. The only surface public transportation route to the GDSCC is by the Fort Irwin Road that leads to Fort Irwin. The NASA Road cutoff from Fort Irwin Road leads into the GDSCC. NASA Road merges with Goldstone Road, which is the only north-south paved access road within the complex. Both NASA and Goldstone Roads are paved two-lane roads and are maintained by the Ft. Irwin Post Engineer. Two-lane paved access roads also lead to each of the sites and major facilities.

2. Utilities and Services

The Southern California Edison Company provides electricity for the Goldstone Complex. The GDSCC provides its own backup diesel-engine generators for operations during emergencies and to ensure continuity of electrical service

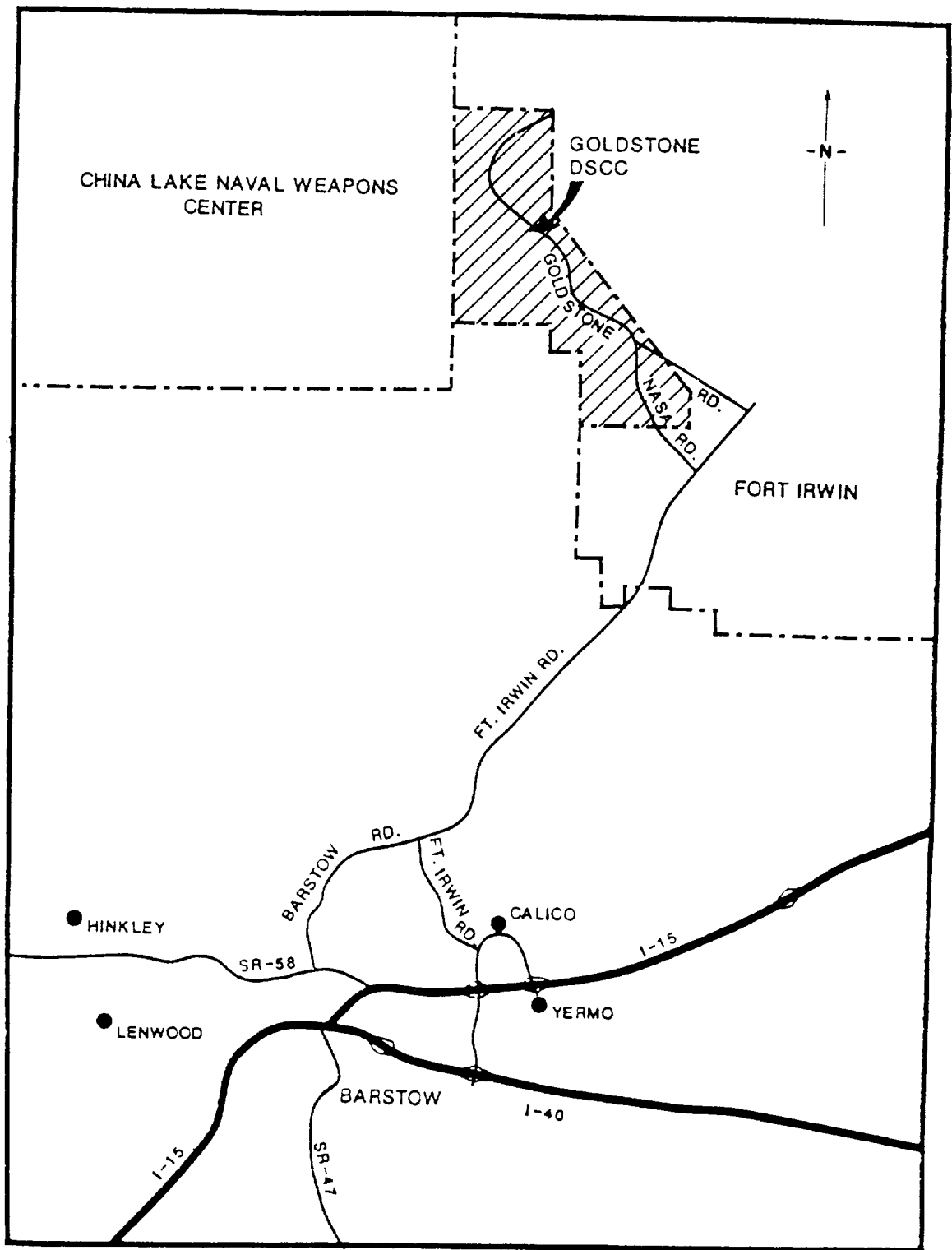


Figure 5. Major Roads Leading to and at the Goldstone DSCC

for prescheduled periods of time. Gasoline, diesel oil, and hydraulic oil are stored in double-walled underground storage tanks fitted with sensors between the walls to detect leaks. Water is supplied by Fort Irwin from groundwater basin wells. Sanitary sewage is discharged through septic tank systems to leaching fields. The Echo and Mars Sites discharge wastewater to evaporation ponds (see JPL Publication 87-4, Environmental Projects: Volume 8, Modifications of Wastewater Evaporation Ponds, October 15, 1989).

G. SOLID-WASTE MANAGEMENT FACILITIES AT THE GDSCC

At the Echo Site, the GDSCC operates its own 10-acre, Class III solid-waste landfill. This facility accepts only non-hazardous, solid wastes.

Most of a small quantity of hazardous waste, generated at the GDSCC each year, is sent to off-site commercial facilities for reclamation and eventual reuse. The remainder is transported to off-site commercial treatment or disposal facilities within 90 days of generation. The GDSCC now has two, new, properly managed storage facilities for hazardous materials and wastes, one at the Echo Site and the other at the Venus Site, but operates no facilities requiring a hazardous waste permit. Details concerning the construction of these two new storage facilities for hazardous materials and wastes at the Echo and Venus Sites are described in JPL Publication 87-4, Environmental Projects: Volume 9, Construction of Hazardous Materials Storage Facilities, November 15, 1989. Two more storage facilities for hazardous materials and wastes, one at the Mars Site and the other at the Apollo Site, will be completed in 1990. In accordance with its environmental management program, the GDSCC conducts all of its waste-management operations in strict compliance with environmental regulations, in a manner consistent with protection of human health and the environment.

H. WASTEWATER MANAGEMENT FACILITIES AT THE GDSCC

Four functioning sewage evaporation ponds - one pair at the Echo Site and another pair at the Mars Site - are designed to receive effluent from upstream septic tank systems. Extensive work was completed in the spring of 1989 to repair and reshape the previously eroded embankments of the wastewater evaporation ponds. Details of this construction work are recorded in JPL Publication 87-4, Environmental Projects: Volume 8, Modifications of Wastewater Evaporation Ponds, October 15, 1989.

I. OPERATIONAL RELATIONSHIPS BETWEEN THE GDSCC AND FORT IRWIN

Because the GDSCC is located within the Fort Irwin property, the two installations potentially can affect each other's roles and missions. Fort Irwin is a U.S. Army installation serving as the U.S. Army National Training Center (NTC). The remote desert environment allows military task forces to practice large-scale training maneuvers that could affect natural, historic, and cultural resources at the GDSCC. This especially is true when the maneuvers involve the movement of heavy equipment (tanks, large trucks) within the GDSCC. Most maneuvers occur at the eastern border of the GDSCC, and every effort is made by both the GDSCC and Ft. Irwin personnel to avoid the use of sensitive areas for such maneuvers.

J. NATURAL ENVIRONMENTAL ASPECTS OF THE GDSCC

1. Geology

The GDSCC is located in the North Central section of the Mojave Desert Province. Typically, the Mojave Desert Province consists of broad, flat plains separated by low mountains (1,000 to 2,000 ft of topographic relief). The GDSCC is situated within one of these low mountain areas.

The GDSCC is located in a naturally occurring bowl-shaped depression bounded on three sides by geological faults. The Garlock Fault lies to the north, while the Blackwater and Calico Faults lie, respectively, to the west and south. The GDSCC is bounded on the east by the Tiefort Mountains. Each antenna site at the GDSCC is located on natural alluvial material, ranging in thickness from 15 feet at the Venus Site to more than 70 feet at the Echo Site. The alluvium is derived from the surrounding hills.

2. Hydrology

Groundwater in the Goldstone area is generally confined and is found at depths ranging from 170 ft near the Minitrack Site to approximately 1,000 ft below the Echo Site. Chemical analyses of the groundwater have yielded total dissolved solids (TDS) values in excess of 1,000 ppm, indicating that the groundwater is brackish. The Goldstone Complex currently obtains potable water from a group of wells located at Fort Irwin, approximately ten miles to the southeast.

3. Climatic Conditions

The GDSCC lies within the U.S. Naval Weather Service's Southwest Desert, Climatic Area A. Mean annual temperatures for the area range from 50° to 80°F. Temperatures can climb as high as 114°F during the summer months, and drop as low as 11°F during the winter months. Mean annual precipitation for the area is approximately 2.5 in.; with most precipitation falling between November and February.

SECTION IV

THE ASBESTOS SURVEY AT THE GDSCC

A. INTRODUCTION

The NASA/JPL/GDSCC and its contractor offices in Barstow, California, recognized that many older buildings/structures at both the Goldstone and Barstow facilities could contain asbestos-containing materials. To eliminate the potential for exposure of its personnel to asbestos, the JPL/GDSCC began its implementation of its Asbestos Management/Abatement Program by contracting in June 1986 with M. B. Gilbert Associates (MBGA), Long Beach, California, to conduct a survey to locate asbestos in the buildings/structures at both the Goldstone and Barstow facilities. This asbestos survey was conducted from October to November 1986, and a report dealing with the results of this buildings/structures survey was issued by MBGA in April 1987.

A letter dated April 20, 1987, sent from Marsha Beck Gilbert, president of MBGA, to Mr. Len Kushner at JPL, dealt with the following subject:

Submittal of Asbestos Survey and Management/Abatement Plan, Contract No. 957527, and Disclaimer Regarding the Asbestos Survey.

A copy of this letter dealing with this original asbestos-survey and its disclaimer is presented in Appendix C.

The original survey of asbestos-containing materials in buildings and structures at the NASA/JPL Goldstone Deep Space Communications Complex (GDSCC), Goldstone, California, excluded several types of asbestos applications, including the following:

- (1) Asbestos in roofing tiles, felts, or papers. The integrity of the roofing would have been disturbed if samples had been taken.
- (2) Asbestos insulation materials inside of boilers. A survey would have required the shutdown of the boilers to obtain samples of suspected asbestos materials.

Thus, subsequent to completion of the original buildings/structures survey, JPL made arrangements for M. B. Gilbert Associates to return to the GDSCC for a second survey to sample roofs and boilers for asbestos. This second field survey was conducted in September 1987. A separate report, dealing with the results of this roofs and boiler survey, was issued by MBGA in October 1987.

A letter dated October 29, 1987, sent from Marsha Beck Gilbert to Mr. Len Kushner, dealt with the following subject:

Submittal of Asbestos Survey of Roofs and Boilers at the Goldstone Deep Space Communications Complex, Contract No. 957527, Modification 4, and Disclaimer Regarding the Asbestos Survey.

A copy of this letter dealing with this second asbestos-survey, involving roofs and boilers of the GDSCC, is presented in Appendix C.

The two MBGA reports, describing the results of both of the above described asbestos surveys, were combined, integrated, and published as JPL Publication 87-4, Volume 4, Environmental Projects: Asbestos Survey (February 1, 1988).

From this point on, therefore, the word "survey" as used in the publication refers to the two separate surveys involving buildings/structures and roofs and boilers at the GDSCC.

The survey determined the quantity, type, and condition of the various asbestos-containing materials at the GDSCC/Barstow facilities. The resultant information base, once compiled into a usable format, then could be used by appropriate JPL/GDSCC personnel to make informed decisions on the scheduling and budgeting of various asbestos-abatement projects.

In general, the survey found that GDSCC practices involving asbestos were conscientious and progressive. Care was taken to avoid worker exposure to asbestos; training of personnel was provided; asbestos-containing wastes were restricted from disposal in the GDSCC solid-waste landfill and, when generated, were properly labeled, bagged, and disposed of at a commercial and permitted hazardous-waste landfill. This present document describes the removal of friable asbestos that was discovered at the GDSCC during the two surveys.

In addition to the building-by-building asbestos survey, the GDSCC conducted a facility-wide asbestos training program, as well as pulmonary function testing and respirator fit-testing for personnel who might come into contact with asbestos during their normal work activities. Details of these training programs are presented in Appendix J of JPL Publication 87-4, Volume 4, Environmental Projects: Asbestos Survey (February 1, 1988).

B. ASBESTOS-SURVEY OBJECTIVES

The asbestos-survey objectives were:

- (1) To survey the buildings/structures at the GDSCC and at the contractor office facilities in Barstow, California, to locate asbestos-containing materials. A further objective was to take samples of roofing materials and boiler insulation at 12 specified building locations to determine their asbestos content. These two objectives were to determine the type, quantity, and condition of these asbestos-containing materials.
- (2) To record findings and sample locations and to compile the data collected during the survey into a format usable by management and asbestos-abatement contractors.
- (3) To make recommendations for asbestos-abatement actions.
- (4) To summarize regulations, procedures, and options for the preparation of the proper asbestos management and abatement plans for buildings/structures and roofs and boilers.

All the above objectives, with their resultant findings, compiled data, drawings, recommendations, and plans, were attained.

C. SCOPE OF THE ASBESTOS SURVEY

1. Selection of Buildings and Structures to be Investigated

The buildings surveyed included all buildings contained in the Directory of Goldstone Buildings and Facilities, December 1985 edition, (Gold Book), with the following exception*:

- (1) The Pioneer Site buildings and structures. The U.S. Army (Ft. Irwin) has assumed responsibility for these facilities.

2. Selection of Roofs and Boilers of Specific Buildings to be Investigated

Roofs surveyed were those at Buildings G-23, G-26, G-33, G-38, G-51, G-53B, G-58, G-60, G-72, G-81, and G-86. Boilers surveyed were those located in Buildings G-21, G-23, G-26, G-33, G-38, G-51, G-72, and G-86.

3. Asbestos Uses Included in the Survey of Buildings/Structures at the GDSCC

The use of asbestos surveyed were those applications in flooring and roofing (except as described below); interior and exterior walls, ceiling tile, and ceilings (including sprayed-on applications); interior and exterior pipes, ducts, boilers, and other insulated equipment (except as described below); asbestos materials in storage, pending use or disposal; and miscellaneous uses of asbestos noted during the course of the survey.

It was established prior to initiation of the field survey that certain asbestos uses would not be surveyed. These uses are listed below:

- (1) Asbestos used in underground piping.
- (2) Other underground occurrences of asbestos.
- (3) Asbestos use in gaskets, where equipment would have to be disassembled to collect a sample.
- (4) Valve gland packings, sealants, lubricants or similar materials used in equipment at the GDSCC.
- (5) Asbestos-wrapped piping and other concealed asbestos materials in walls, where wall materials would require removal or destruction to obtain samples.

*Since this Asbestos Survey at the GDSCC was conducted in 1986-87, a new edition of the Gold Book has been published (Directory of Goldstone DSCC Buildings and Supporting Facilities, Gold Book, Document 890-165, October 1989).

- (6) Asbestos in flooring tiles, felts, or papers, where the integrity of the flooring would be disturbed if samples were taken.
- (7) Asbestos in roofing tiles, felts, or papers, where the integrity of roofing would be disturbed if samples were taken. The second asbestos survey, however, did include these asbestos uses (see Section IV C4, below).
- (8) Asbestos insulation materials inside of motors, active boilers, or other active equipment. The second asbestos survey, however, did include these asbestos uses (see Section IV C4, below).
- (9) Asbestos in concrete parking curbs or other preformed concrete items.

While these potential sources of asbestos were not investigated in the original field survey of buildings/structures, the field team reported any suspicions of their existence to the JPL/GDSCC management staff.

4. Asbestos Uses Included in the Survey of Roofs and Boilers

The second field survey at the GDSCC, in September 1987, however, did include the uses of asbestos in roofing and boiler-insulation materials in 12 selected buildings at the GDSCC.

D. ORGANIZATION OF JPL PUBLICATION 87-4, VOLUME 4, ENVIRONMENTAL PROJECTS: ASBESTOS SURVEY (FEBRUARY 1, 1988)

After four sections of introductory material, the Asbestos Survey report is organized into an additional seven sections. Section V provides a summary and conclusion of findings of the two GDSCC asbestos surveys. Section VI provides an inventory compilation of field data for each building and structure that was surveyed at the GDSCC and was found to contain asbestos material(s). Drawings of buildings, which show sample locations and the location of materials that were positively identified as containing asbestos, were incorporated. Section VII deals with an Asbestos Abatement Plan that can be adapted for use at the GDSCC. Section VIII is an Asbestos Management Plan that can serve as the basis for a GDSCC asbestos management plan. Section IX outlines a plan for the abatement of friable asbestos at the GDSCC. Section X is a bibliography of pertinent source and reference materials dealing with the asbestos problem, while Section XI is a certification of the work involved in the asbestos survey. The report concludes with eleven Appendixes that provide further details about the two asbestos surveys at the GDSCC.

SECTION V

SUMMARY AND CONCLUSIONS OF THE ASBESTOS SURVEY AT THE GDSCC

A. GENERAL FINDINGS

1. Occurrences and Uses of Asbestos in Buildings/Structures at the GDSCC

Of the more than 93 buildings and structures at the GDSCC, 91 were surveyed for asbestos. Locations not surveyed include the following:

- (1) Those buildings and structures at Pioneer Station that are no longer managed by JPL/GDSCC were not surveyed and are not included in the list of 91 surveyed buildings. Buildings/structures G-6, G-7, and G-12 at Pioneer Station are still under JPL/GDSCC management, and these were surveyed.

Table 4 presents a listing of the 91 buildings and structures surveyed at the GDSCC. Buildings and structures are referred to collectively as "buildings." The table identifies whether the building listed was not surveyed, whether it was surveyed and sampled for asbestos (asbestos present, no asbestos present), or whether it was surveyed but not sampled for asbestos (inspection only).

Of the buildings surveyed, asbestos was positively identified at 38 buildings. This represents approximately 41% of all buildings at the GDSCC. The 38 facilities have 49 uses of asbestos in pipe lagging, exterior siding, roofing, interior walls, floors, ceilings, heating vessels, and/or miscellaneous materials. This value does not take into account the discrete occurrences of asbestos (e.g., each pipe run that is wrapped in asbestos in a building), but indicates that a building has several uses of asbestos (e.g., asbestos in pipes, walls, and roofing). The total number of occurrences of asbestos was found to be 103, based on 288 unique samples collected and tested. Survey sample results are provided in Appendix D.

The distribution of uses of asbestos at GDSCC are:

- (1) Twelve buildings have asbestos-wrapped pipes.
- (2) One building has exterior siding containing asbestos.
- (3) Three buildings have roofing materials containing asbestos.
- (4) Four buildings have interior walls containing asbestos.
- (5) Twenty-eight buildings have flooring containing asbestos.
- (6) One building has asbestos-wrapped heating vessels.
- (7) No asbestos was discovered at the Pioneer Site.
- (8) Sixteen of twenty-six buildings surveyed at the Echo Site contain asbestos.

- (9) Five of fourteen buildings surveyed at the Venus Site contain asbestos.
- (10) Two of three buildings surveyed at the airport contain asbestos.
- (11) The single and only building at the Microwave Test Facility was surveyed and shown to contain asbestos.
- (12) Two of fourteen buildings surveyed at the Mars Site contain asbestos.
- (13) Nine of twenty-three buildings at the Apollo Site contain asbestos.
- (14) One of five buildings at the Mojave Base Site contains asbestos.
- (15) One of three miscellaneous locations (G-92 Pump House, G-93 Main Gate House, and G-100 Radio Spectrum Monitor) contains asbestos.
- (16) The single and only building at the Barstow office facility contains asbestos.

2. Occurrences of Asbestos-Containing Materials in Roofs and Boilers at Specified Buildings at the GDSCC

Asbestos was found at five of the twelve buildings at GDSCC that were surveyed for asbestos-containing materials in roofs and boilers. Table 5 presents the results of tests for asbestos-containing materials in roofs and boilers at specified buildings at the GDSCC. A report of laboratory analyses is included in Appendix B.

Of the 12 buildings surveyed, 11 were surveyed for roofing and 10 were surveyed for boilers. Asbestos was positively identified at five (42%) of the 12 buildings (G-26, G-38, G-72, G-81, and G-86). Five of the 11 buildings surveyed for roofs (45%) contained asbestos (G-26, G-38, G-72, G-81, and G-86). Three of the 10 buildings surveyed for boilers (30%) contained asbestos (G-26, G-38, and G-72).

Table 4. Summary of Findings of Buildings Surveyed for Asbestos-Containing Materials at the GDSCC^a

Site	Bldg. No.	Building Name	Survey Findings ^b	
Pioneer	G-6	Collimation Tower	0	
	G-7	Collimation Bldg.	0	
	G-12	ACU Radio Repeater	0	
Echo	G-21	Admin/Engr/Cafeteria	Pos.	A,G
	G-22	Fire Line Pump House	Pos.	A
	G-23	Dormitory	Pos.	A,F,G
	G-24	Power Plant/Generator	Pos.	G
	G-25	Transportation/Maintenance	Pos.	G
	G-26	Operations Control	Pos.	A,G
	G-27	Storage	Pos.	A
	G-28	Machine Shop	Neg.	
	G-29	Storage	Neg.	
	G-30	Storage	0	
	G-33	Engineering/Communications	Pos.	A,G
	G-34	Hydro-Mechanical Bldg.	Neg.	
	G-35	34-M Antenna	0	
	G-36	Collimation Building	Pos.	G
	G-37	Seismic Laboratory	Pos.	G
	G-38	Facility Services	Pos.	A,G
	G-39	Paint Shop	0	
	G-40	Flammable Storage	0	
	G-41	Supply Warehouse	Neg.	
	G-42	Garage	Pos.	G
	G-43	Storage	Neg.	
	G-44	Drum Storage	Pos.	C
	G-45	Storage	Pos.	G
	G-46	Antenna Repair Shop	Pos.	A ^c
	G-47	Carpenter Shop	Pos.	G
	G-48	Collimation Tower	0	

^aBuildings are listed in the order presented in the Directory of Goldstone Buildings and Facilities.

^b0 = No suspect material observed; samples were not taken.

Neg. = laboratory analysis was negative for asbestos.

Pos. = laboratory analysis was positive for asbestos.

A = Asbestos found in pipe exterior insulation.

B = Asbestos found in roofing materials.

C = Asbestos found in wallboard.

D = Asbestos found in plenum areas.

E = Asbestos found in ceiling materials.

F = Asbestos found in steam vessel/boiler insulation.

G = Asbestos found in floor tile.

H = Asbestos found in miscellaneous uses.

^cPipe lying on ground, outside of Bldg. G-46, SE corner.

Table 4. (Cont'd)

Site	Bldg. No.	Building Name	Survey Findings ^b	
Venus	G-51	Operations Control	Pos.	A,C,G
	G-52	26-M Antenna	Neg.	
	G-53A	Transmitter	Pos.	G
	G-53B	26-M Hydro-Mechanical	0	
	G-54	Collimation Tower	0	
	G-55	9-M Antenna	Pos.	H ^d
	G-56	Security Bldg.	Pos.	G
	G-57	Collimation Bldg.	0	
	G-58	9-M Hydro-Mechanical/ Transmitter	Pos.	A
	G-60	Laboratory/ Office	Neg.	
	G-61	100 KW Transmitter	0	
	G-62	Fire Line Pump House	0	
	G-63	Workshop/Warehouse	Neg.	
	G-67	Distilled Water	0	
Airport	G-69	Airport Shelter	0	
	G-70	Battery/Portable Generator	Pos.	B
	G-71	Airport Facility	Pos.	G
Microwave Test Facility	G-72	Microwave Test Facility	Pos.	A,G
Mars	G-80	64-M Antenna	Pos.	G
	G-81	Power Plant/Generator	Neg.	
	G-82	Fire Line Pump/ Cooling Equipment	0	
	G-83	Cooling Tower	0	
	G-84	Training/ Office	Neg.	
	G-85	Flammable Storage	0	
	G-86	Operations Control	Pos.	A,G
	G-87	Security	Neg.	
	G-88	Transformer Rectifier	0	
	G-89	Reverse Osmosis Equipment	0	
	G-90	Storage	0	
	G-91	Switchgear	Neg.	
	G-94	Fire Line Pump House	0	
	G-95	34-M Antenna	0	
Misc.	G-92	Pump House	0	
	G-93	Main Gate House	Pos.	G
	G-100	GDSCC Radio Spectrum Monitor	0	
^d Equipment box wrapped in asbestos-containing fabric.				

Table 4. (Cont'd)

Site	Bldg. No.	Building Name	Survey Findings ^b	
			Pos.	G
Barstow		Barstow Office Building	Pos.	G
Apollo	A-1	Operations	Pos.	G
	A-2	Administration	Pos.	G
	A-3	26-M Hydro-Mechanical	0	
	A-4	26-M Collimation Tower	Neg.	
		Equipment Bldg.		
	A-5	Hydrorepair Bldg.	Pos.	He
	A-6	Microwave Terminal ^f		
	A-7	9-M Equipment House	Pos.	C
	A-8	9-M Collimation Tower	Pos.	B
	A-12	Apollo Fire Pump House	Neg.	
	A-14	Logistics Storage	0	
	A-85	26-M Antenna	Neg.	
	A-86	Collimation Tower	0	
	A-87	9-M Antenna	Neg.	
	A-88	Collimation Tower	0	
	M-1	Minitrack	Pos.	G
	M-2	Logistics	Pos.	G
	M-3	Utility	0	
	M-4	Camera Shelter	0	
	M-6	Telemetry	Pos.	A,B,G
	M-7	Transmitter	0	
	M-9	Power Plant/Generator	Pos.	G
	M-10	Flammable Storage	0	
	M-17	Mojave Fire Pump House	Neg.	
Mojave	M-5	12-M Collimation Tower ^f		
	M-8	Operations Building	Pos.	G
	M-12	CDP Depot Maintenance Bldg.	0	
	M-13	Equipment Building	0	
	M-50	12-M Antenna/Antenna Bldg.	0	

^eAsbestos blanket and gloves lying on shelf inside building.

^fNot surveyed.

Table 5. Results of Tests for Asbestos-Containing Materials in Roofs and Boilers at Specified Buildings at the GDSCC^a

Site	Bldg. No.	Building Name	Material Surveyed	Test Result ^b
Echo	G-21	Admin/Engr/Cafeteria	Boiler	Neg.
	G-23	Dormitory	Boiler	Neg.
			Roof	Neg.
	G-26	Operations Control	Boiler	Pos.
			Roof	Pos.
	G-33	Engineering/Communications	Boiler	Neg.
			Roof	Neg.
Venus	G-38	Facility Services	Boiler	Pos.
			Roof	Pos.
	G-51	Operations Control	Boiler	Neg.
	G-53B	26-M Hydro-Mechanical	Roof	Neg.
	G-58	9-M Hydro-Mechanical/ Transmitter	Roof	Neg.
	G-60	Laboratory/Office	Roof	Neg.
Microwave Test Facility	G-72	Microwave Test Facility	Boiler	Pos.
			Roof	Pos.
Mars	G-81	Power Plant/Generator	Roof	Pos. ^c
	G-86	Operations Control	Boiler	Neg. ^d
			Roof	Pos. ^d

^aBuildings are listed in the order presented in the Directory of Goldstone Buildings and Facilities.

^bNeg. = laboratory analysis was negative for asbestos.

Pos. = laboratory analysis was positive for asbestos.

^cThe positive portion of the roof is the higher roof only at the west end of the building.

^dThe Building G-86 boiler was inspected and not sampled. The boiler is a Model I-1 Precision Parts Corporation electric boiler that was installed in 1979. All materials located in the boiler were fiberglass. The positive portion of the roof is the higher roof only at the east end of the building.

3. Incidental Uses of Asbestos-Containing Material at the GDSCC

The majority of asbestos-containing material identified at the GDSCC is used for insulation (pipe insulation, boiler jacketing), or construction materials (siding, floor tiles, roofing felts, and paneling). Very small amounts of asbestos-containing materials, however, may be contained in equipment; motors; appliances, such as heating elements; valve gland packings; stove linings; gaskets; etc. (see Table 2 for additional examples of asbestos use in commerce). These uses of asbestos-containing materials do not normally pose a significant existing hazard to workers because the asbestos content is non-friable, generally enclosed, and of small quantity. Some of these uses of asbestos may be present at the GDSCC. For this reason, it is recommended that the following precautions be taken:

- (1) The GDSCC Purchasing Department should stipulate to future suppliers that no items should contain asbestos materials. Substitute materials generally are available.
- (2) Maintenance personnel should be made aware of the possibility of asbestos materials being present in certain items (valve packings and gasket material) and in specified areas at the GDSCC. Personnel should be properly trained to work with asbestos-bearing materials, and should be required to follow established written procedures for handling and disposing of these items during maintenance and replacement activities.

The MBGA survey team collected samples of several items identified above as miscellaneous or incidental uses. Samples of gasket material, fireproof blankets and gloves, underground telephone conduit, underground water pipe, and woven cloth found in the air-conditioning system were collected for analysis. Test results for these materials were positive for asbestos and were included in the asbestos inventory in Section VI of JPL Publication 87-4, Volume 4, Environmental Projects: Asbestos Survey (February 1, 1988).

Analysis of several samples of engine gasket materials reveals that some of the older gasket material used at the GDSCC does contain asbestos. Both prefabricated gaskets and gasket sheeting for hand-cut gaskets were found to contain asbestos. The prefabricated gaskets are considered non-friable and are considered to pose no significant health hazard unless they are modified in such a manner as to generate dust (cutting, sanding, filing). The gasket sheeting, which is cut to form custom gaskets, is handled in a manner that can produce asbestos dust.

It is recommended that use of this gasket-sheeting material be discontinued, and a suitable replacement be found. If an asbestos-containing gasket must be used, it should be handled following established written procedures that include specifications for personnel protection. The asbestos cuttings or scrap material should be disposed of in a Class I or designated Class II landfill. The Echo Site landfill is a Class III facility. As such, it is not approved for disposal of asbestos.

4. Quantities of Asbestos in Buildings and Structures at the GDSCC

There is an estimated 83,583 square feet (SF) of asbestos in buildings and structures at the GDSCC. This includes all asbestos identified during the survey, except asbestos in pipe wrapping. The quantity of asbestos in pipe wrapping, generally expressed in linear feet (LF) rather than square feet, is estimated to be 645 LF.

The quantity of asbestos-containing material found to exist at the GDSCC, reported in units of linear or square feet for each use of asbestos, is listed in Table 6. The table shows that an estimated 74,696 SF of asbestos-containing material is present in flooring materials. This represents about 89 percent of all asbestos identified during the survey and is the largest single use of asbestos at the GDSCC.

Estimated quantities of each use of asbestos found in or adjacent to buildings at the GDSCC and the percentage of that use at the GDSCC is summarized below:

- (1) Twelve buildings/structures contain 645 LF of friable asbestos-insulated pipe.
- (2) One building contains 812 SF (less than 1%) of non-friable exterior siding that contains asbestos.
- (3) Three buildings contain 5,217 SF (6%) of non-friable roofing containing asbestos.
- (4) Four buildings contain 2,816 SF (3%) of non-friable asbestos in interior transite walls and partitions.
- (5) Asbestos was not discovered in ceiling tiles or other ceiling materials.
- (6) Twenty-eight buildings contained 74,696 SF (89%) of non-friable asbestos floor tiles.
- (7) One building contains 42 SF (less than 1%) of asbestos boiler jacketing.

5. Estimated Quantities of Asbestos-Containing Materials Found in Roofing Materials and Boiler Insulation at the GDSCC

There is an estimated 30,228 square feet (SF) of asbestos-containing material in Buildings G-26, G-38, G-72, G-81, and G-86. Of this square footage, only 4.03 SF is estimated to occur in boiler insulating material and 30,224 SF is estimated to occur in roofing material. Quantities of asbestos-containing material found in each of the above-listed buildings are shown in Table 7.

Table 6. Asbestos-Containing Materials Found at the GDSCC

Building No.	Pipes (LF)	Siding (SF)	Roofing (SF)	Walls (SF)	Ceilings (SF)	Floors (SF)	Vessels (SF)
G-21	37	0	0	0	0	7,700	0
G-22	1	0	0	0	0	0	0
G-23	54	0	0	0	0	2,443	42
G-24	0	0	0	0	0	1,294	0
G-25	0	0	0	0	0	240	0
G-26	32	0	0	672	0	1,831	0
G-27	1	0	0	0	0	0	0
G-33	237	0	0	0	0	3,310	0
G-36	0	0	0	0	0	289	0
G-37	0	0	0	0	0	492	0
G-38	59	0	0	0	0	5,849	0
G-42	0	0	0	0	0	577	0
G-44	0	812	0	0	0	0	0
G-45	0	0	0	0	0	111	0
G-47	0	0	0	0	0	1,247	0
G-53A	0	0	0	0	0	676	0
G-56	0	0	0	0	0	100	0
G-58	1	0	0	0	0	0	0
G-70	0	0	360	0	0	0	0
G-71	0	0	0	0	0	360	0
G-72	32	0	0	0	0	2,391	0
G-80	0	0	0	0	0	3,000	0
G-86	98	0	0	768	0	7,150	0
G-93	0	0	0	0	0	270	0
Barstow	0	0	0	0	0	23,212	0
A-1	0	0	0	0	0	4,116	0
A-2	0	0	0	0	0	3,400	0
A-7	0	0	0	256	0	0	0
A-8	0	0	128	0	0	0	0
M-1	0	0	0	0	0	16	0
M-2	0	0	0	0	0	840	0
M-6	25	0	4,729	0	0	778	0
M-9	0	0	0	0	0	160	0
M-8	0	0	0	0	0	1,344	0
Subtotals	645	812	5,217	2,816	0	74,696	42

Total SF of all asbestos uses at the GDSCC,
except pipe wrap

83,583 SF

Table 7. Quantities of Asbestos-Containing Materials found in Roofing and Boilers at Specified Buildings Surveyed at the GDSCC

Site	Building Number	Roofing (SF)	Boilers (SF)
Echo	G-26	11,508	1.29
Echo	G-38	9,396	1.29
MTF	G-72	2,880	1.45
Mars	G-81	5,000	0.00
Mars	G-86	1,440	0.00
Subtotal SF		30,224	4.03
Estimated Total SF of Roofs and Boilers		30,228 SF	

SF means square feet.

6. Asbestos-Sampling Programs

The asbestos sampling programs were designed to collect samples of suspected asbestos material from locations that could be sampled by the survey team without causing damage to property or without creating undue risk to the health and safety of both the survey team and GDSCC personnel. Generally, GDSCC management was consulted when decisions had to be made regarding these issues.

One sampling problem arose while collecting samples of roofing material. There are three types of roofing finishes used at the GDSCC: corrugated metal roofing; fiberglass-reinforced roof coating with reflective surfacing; and mineral-surfaced cap sheet (pebble and tar) assumed to be underlain by felt or fiberglass ply sheets.

The corrugated roofing was metal only and was not sampled. Using a hand auger for boring, the fiberglass-reinforced roofing could not be penetrated to obtain samples of underlying felt or ply sheets. No samples of underlying materials, therefore, were obtained. A small piece of resinous material that was collected tested negative for asbestos. It should be noted that felts or ply sheets typically are laid under fiberglass coatings and that fiberglass finishes often are applied over old mineral-surfaced roofing materials. Thus when these non-sampled roofs are to be replaced, the GDSCC should take a conservative view and assume the possibility of asbestos being present in this type of roofing. These roofing materials should be sampled for asbestos prior to their removal and disposal.

Eleven samples of mineral-surfaced roofing were collected and tested for asbestos content. Of these, three samples tested positive for asbestos. Several roofs were not sampled because the thickness of the tar layer on these roofs was too great to allow a sample to be obtained by boring with a hand auger. Again, it is recommended that the GDSCC assume that asbestos is present in the mineral-surfaced roofs that were not sampled. Thus, when these roofs are to be replaced, they should be sampled for asbestos content prior to their removal and disposal.

In the second field survey, however, conducted in September 1987, roofs and boiler-insulation materials of 12 selected buildings at the GDSCC subsequently were sampled for asbestos through the use of power tools for boring. The holes that were left in the roof, following removal of the bored-out samples, were then plugged up by GDSCC personnel.

B. CONDITION OF ASBESTOS IN BUILDINGS AND STRUCTURES AT THE GDSCC

The condition of asbestos in buildings/structures at the GDSCC was found to be either 1) undisturbed, 2) having some water damage, 3) having some physical damage, or 4) having some evidence of delamination.

All the sampled roofs that contained asbestos were found to have some physical damage. All the sampled boiler insulation that contained asbestos was found to be in an undisturbed condition.

A summary of the condition of asbestos found in buildings/structures at the GDSCC and recommendations for abatement timing and methods are provided in Table 8. Similarly, a summary of the condition of asbestos found in roofs and

boilers at the GDSCC and recommendations for abatement timing and methods are provided in Table 9.

The following summary of data taken from Table 8 provides a profile of conditions identified in the 34 asbestos-containing buildings and structures listed in Table 6:

- (1) Forty-one of 109 occurrences of asbestos found at the GDSCC are in an undisturbed condition.
- (2) Sixty-one of 109 occurrences of asbestos found at the GDSCC have some physical damage.
- (3) One of 109 occurrences of asbestos found at the GDSCC had some water damage.
- (4) Two of 109 occurrences of asbestos found at the GDSCC have some delamination evident.
- (5) Thirty-eight of 49 pipe wraps sampled have some physical damage and one pipe wrap has evidence of delamination. These conditions occur in nine buildings. Ten of the 49 pipe wraps are undisturbed.

A review of the data of Table 8 shows occurrences of asbestos at the GDSCC to warrant near-future abatement action. Buildings G-21, G-22, G-23, G-26, G-27, G-33, G-38, G-51, G-58, G-72, G-86, and M-6 are identified as requiring abatement in the near future. The remainder of the buildings do not at this time require abatement prior to demolition, repair, or damage, since they contain non-friable materials with little or no physical damage.

C. RATIONALE FOR SUGGESTED TIMING OF ASBESTOS ABATEMENT

In Section VI of this report, recommendations are made for timing abatement actions for each occurrence of asbestos at the GDSCC. Three categories of abatement timing are considered:

- (1) IMMEDIATE: This implies actual or imminent hazard to personnel and some rapid remedial measures are required.
- (2) NEAR FUTURE: This category covers most of the friable asbestos pipe and vessel wrapping at the GDSCC. It applies primarily to any friable insulation that is in a high population area or for any friable material that is extensively damaged. It implies that a decision should be made as to whether the asbestos-containing material should be totally removed or only damaged areas repaired and undisturbed material left in place. The NEAR FUTURE category implies a need to make decisions in the near future. If friable asbestos is not removed, a periodic routine surveillance program must be established.
- (3) AT THE TIME OF DEMOLITION, REPAIR, OR DAMAGE: This category covers those conditions where no apparent hazard to personnel can be envisioned, unless material is damaged or being worked on in a manner to cause dust to be generated (e.g., sawing, drilling, etc.).

Table 8. Condition of Asbestos at the GDSCC and
Recommended Abatement Timing

Bldg. No. ^a	Ref. No. ^b	Condition of Asbestos Material	Recommended Abatement Timing	Recommended Removal Method
G-21	AA	Some physical damage	Near future	Removal
G-21	AC	Some physical damage	Near future	Removal
G-21	AD	Some physical damage	Near future	Removal
G-21	AE	Some physical damage	Near future	Removal
G-21	AG	Some physical damage	Near future	Removal
G-22	AA	Some physical damage	Near future	Removal
G-23	AD	Some physical damage	Near future	Removal
G-23	AF	Some physical damage	Near future	Removal
G-23	AI	Some physical damage	Near future	Removal
G-23	AK	Some physical damage	Near future	Removal
G-23	AM	Some physical damage	Near future	Removal
G-26	AA	Some physical damage	Near future	Removal
G-26	AC	Some physical damage	Near future	Removal
G-26	AE	Some physical damage	Near future	Removal
G-26	AG	Some physical damage	Near future	Removal
G-26	AJ	Some physical damage	Near future	Removal
G-26	AL	Some physical damage	Near future	Removal
G-27	AA	Some physical damage	Near future	Removal

^aList of buildings in which asbestos positively was identified.

^bThe first letter in a reference number refers to a specific use of asbestos. The second letter refers to the number of occurrences of the specified use in a given building. For example: Bldg. No. G-33 and Ref. No. AD means the fourth pipe in Building G-33 that was found to be wrapped in an asbestos-containing material, since A stands for pipe wrap and D is the fourth letter in the alphabet. The key for asbestos use follows:

- A = asbestos found in pipe wrap insulation.
- B = asbestos found in exterior siding or roofing materials.
- C = asbestos found in wall structures or partitions.
- F = asbestos found in steam vessel or boiler wrap insulation.
- G = asbestos found in floor tile.
- H = miscellaneous uses of asbestos.

Table 8. (Cont'd)

Bldg. No.	Ref. No.	Condition of Asbestos Material	Recommended Abatement Timing	Recommended Removal Method
G-33	AC	Some physical damage	Near future	Removal
G-33	AD	Some physical damage	Near future	Removal
G-33	AG	Some physical damage	Near future	Removal
G-33	AK	Some physical damage	Near future	Removal
G-33	AL	Some physical damage	Near future	Removal
G-33	AN	Some physical damage	Near future	Removal
G-33	AP	Some physical damage	Near future	Removal
G-33	AR	Some physical damage	Near future	Removal
G-33	AT	Some physical damage	Near future	Removal
G-38	AB	Some physical damage	Near future	Removal
G-38	AF	Some physical damage	Near future	Removal
G-38	AG	Some physical damage	Near future	Removal
G-38	AH	Some physical damage	Near future	Removal
G-38	AI	Some physical damage	Near future	Removal
G-38	AJ	Some physical damage	Near future	Removal
G-86	AA	Some physical damage	Near future	Removal
G-86	AB	Some physical damage	Near future	Removal
G-86	AC	Some physical damage	Near future	Removal
G-86	AD	Some physical damage	Near future	Removal
G-51	AD	Some delamination evident	Near future	Removal
G-23	FA	Undisturbed	Near future	Removal
G-51	AB	Undisturbed	Near future	Removal
G-51	AE	Undisturbed	Near future	Removal
G-51	AF	Undisturbed	Near future	Removal
G-58	AA	Undisturbed	Near future	Removal
G-72	AB	Undisturbed	Near future	Removal
G-72	AE	Undisturbed	Near future	Removal
G-72	AF	Undisturbed	Near future	Removal
G-72	AH	Undisturbed	Near future	Removal

Table 8. (Cont'd)

Bldg. No.	Ref. No.	Condition of Asbestos Material	Recommended Abatement Timing	Recommended Removal Method
G-72	AJ	Undisturbed	Near future	Removal
M-6	AA	Undisturbed	Near future	Removal
G-21	GC	Some physical damage	Time of demolition	Removal
G-33	GB	Some physical damage	Time of demolition	Removal
G-44	CA	Some physical damage	Time of demolition	Removal
G-47	GA	Some physical damage	Time of demolition	Removal
G-51	CA	Some physical damage	Time of demolition	Removal
G-56	GA	Some physical damage	Time of demolition	Removal
G-71	GA	Some physical damage	Time of demolition	Removal
G-72	GA	Some physical damage	Time of demolition	Removal
G-72	GB	Some physical damage	Time of demolition	Removal
G-72	GC	Some physical damage	Time of demolition	Removal
G-72	GD	Some physical damage	Time of demolition	Removal
G-80	GA	Some physical damage	Time of demolition	Removal
G-80	GC	Some physical damage	Time of demolition	Removal
G-80	GD	Some physical damage	Time of demolition	Removal
G-86	GA	Some physical damage	Time of demolition	Removal
A-2	GB	Some physical damage	Time of demolition	Removal
A-2	GC	Some physical damage	Time of demolition	Removal
M-2	GA	Some physical damage	Time of demolition	Removal
M-2	GB	Some physical damage	Time of demolition	Removal
M-6	BA	Some physical damage	Time of demolition	Removal
M-9	GA	Some physical damage	Time of demolition	Removal
A-2	GA	Some delamination evident	Time of demolition	Removal
G-33	GC	Some physical damage	Time of demolition	Removal
G-36	GA	Some physical damage	Time of demolition	Removal
G-38	GB	Some physical damage	Time of demolition	Removal
G-37	GA	Some water damage	Time of demolition	Removal
G-21	GA	Undisturbed	Time of demolition	Removal
G-21	GB	Undisturbed	Time of demolition	Removal

Table 8. (Cont'd)

Bldg. No.	Ref. No.	Condition of Asbestos Material	Recommended Abatement Timing	Recommended Removal Method
G-23	GA	Undisturbed	Time of demolition	Removal
G-24	GA	Undisturbed	Time of demolition	Removal
G-24	GB	Undisturbed	Time of demolition	Removal
G-25	GD	Undisturbed	Time of demolition	Removal
G-26	CA	Undisturbed	Time of demolition	Removal
G-26	GB	Undisturbed	Time of demolition	Removal
G-26	GC	Undisturbed	Time of demolition	Removal
G-26	GD	Undisturbed	Time of Demolition	Removal
G-33	GA	Undisturbed	Time of demolition	Removal
G-33	GD	Undisturbed	Time of demolition	Removal
G-42	GA	Undisturbed	Time of demolition	Removal
G-42	GB	Undisturbed	Time of demolition	Removal
G-42	GC	Undisturbed	Time of demolition	Removal
G-45	GA	Undisturbed	Time of demolition	Removal
G-51	GA	Undisturbed	Time of demolition	Removal
G-53A	GA	Undisturbed	Time of demolition	Removal
G-70	BA	Undisturbed	Time of demolition	Removal
G-86	CA	Undisturbed	Time of demolition	Removal
G-93	GC	Undisturbed	Time of demolition	Removal
Barstow	GA	Undisturbed	Time of demolition	Removal
Barstow	GB	Undisturbed	Time of demolition	Removal
A-1	GA	Undisturbed	Time of demolition	Removal
A-7	CA	Undisturbed	Time of demolition	Removal
A-8	BA	Undisturbed	Time of demolition	Removal
M-1	GB	Undisturbed	Time of demolition	Removal
M-1	GC	Undisturbed	Time of demolition	Removal
M-6	GA	Undisturbed	Time of demolition	Removal
M-8	GB	Undisturbed	Time of demolition	Removal

Table 9. Condition of Asbestos in Roofs and Boilers at Specified Buildings at the GDSCC and Recommended Abatement Timing

Bldg. No. ^a	Sample Number ^b	Use	Condition of Asbestos Material	Recommended Abatement Timing	Recommended Removal Method
G-26	31	Boiler	Undisturbed	Time of replacement, repair, or demolition	Removal
G-26	15	Roof	Some physical damage	Time of replacement, repair, or demolition	Removal
	16	Roof			
	18	Roof			
G-38	25	Boiler	Undisturbed	Time of replacement, repair, or demolition	Removal
G-38	11	Roof	Some physical damage	Time of replacement, repair, or demolition	Removal
G-72	43	Boiler	Undisturbed	Time of replacement, repair, or demolition	Removal
G-72	20	Roof	Some physical damage	Time of replacement, repair, or demolition	Removal
G-81	22	Roof	Some physical damage	Time of replacement, repair, or demolition	Removal
G-86	23	Roof	Some physical damage	Time of replacement, repair, or demolition	Removal

^a List of only those buildings in which asbestos in roofs or boilers was positively identified.

^b Last two digits of sample number (See Appendix B).

As can be seen in Table 8, friable asbestos-containing insulation in buildings/structures, except undamaged metal-wrapped insulation, falls into the NEAR-FUTURE timing category. This is a conservative approach. The rationale for recommending NEAR-FUTURE removal of pipe and boiler insulation in good, undisturbed condition is based on the high probability for future asbestos release, should the insulation be damaged. There are alternatives to removal, such as enclosure (the installation of metal lagging over asbestos wrapping). This involves a cost in the asbestos abatement program, however, that does not alleviate the potential for future exposures to asbestos.

All friable asbestos-containing boiler insulation identified during the survey is undamaged and metal-wrapped. Thus, the suggested timing of asbestos abatement for boiler insulation is AT THE TIME OF DEMOLITION, REPAIR, OR DAMAGE. The criteria used in determining abatement timing are found in Table 10.

The only other feasible alternative to removal is to periodically monitor the condition of all friable insulation on pipes and boilers for as long as the asbestos remains in place. At the time of building or structure demolition, asbestos-containing materials will have to be removed separately anyway.

Two recommendations for abatement action are considered sufficient to cover all combinations of conditions identified. These recommendations are for removal in the near future and removal at the time of demolition or extensive damage. Although NASA guidance does not recommend removal of asbestos simply because of its presence, all friable asbestos materials found in pipe and boiler wrap at the GDSCC is to be removed. This is to protect the health of maintenance personnel who may be exposed to friable asbestos fibers during repair or restructuring work on pipes and boilers.

The removal of friable asbestos from the GDSCC is the subject of this present report.

All other asbestos-containing materials found at the GDSCC are non-friable and do not require abatement unless these materials are severely disturbed or damaged. For non-friable asbestos-containing materials, therefore, abatement is recommended at the time of damage or building demolition. The removal of some non-friable asbestos-containing materials at the GDSCC will be the subject of a future report in this continuing series of reports dealing with environmental projects at the GDSCC.

Table 10. Guidance for the Selection of the Suggested Timing for Asbestos-Abatement Procedures

Description of Material	Immediate	Near Future	Demolition/ Repair/Damage
1. Interior spray-on friable w/personnel exposed (none found)	X		
2. Exterior spray-on friable w/personnel exposed (none found)	X		
3. Exterior non-friable siding/roofing in good condition			X
4. Exterior non-friable siding/roofing, deteriorated (none found)		X	
5. Interior non-friable walls/ceilings/floors in good condition			X
6. Interior non-friable walls/ceilings/floors, deteriorated (none found)		X	
7. Plenum area w/sprayed-on asbestos-bearing material (none found)		X	
8. Plenum area w/sprayed-on asbestos-bearing material, badly damaged (none found)	X		
9. Pipes, and steam vessels, interior and exterior, with asbestos-containing insulation, <u>undamaged</u>		X	
10. Pipes and steam vessels, interior and exterior, with asbestos-containing insulation, which is severely damaged	X		
11. Pipes with <u>undamaged metal</u> insulation wrapping			X

SECTION VI

FRIABLE ASBESTOS-ABATEMENT PROGRAM AT THE GDSCC

A. INTRODUCTION

Two asbestos surveys carried out in 1986 and 1987 by M. B. Gilbert Associates, Long Beach, California, identified the buildings/structures where the various forms of asbestos were located at the GDSCC. The two asbestos surveys are described in JPL Publication 87-4, Volume 4, Environmental Projects: Asbestos Survey (February 1, 1988).

Friable asbestos, which was found in all pipe coverings at the GDSCC, is defined as a material that contains more than one-percent asbestos by weight and, when dry, can easily be crumbled, pulverized, or reduced to a powder merely by hand pressure. Obviously, friable asbestos is the most dangerous form of asbestos because during preventive or breakdown maintenance of asbestos-insulated pipes and pipe fittings, asbestos fibers readily can be released into the environment. Air circulation then could spread the released asbestos fibers throughout a building/structure. This is a potential hazard for GDSCC personnel, in general, and for maintenance, custodial and janitorial personnel, in particular.

Many asbestos-abatement experts believe that the only satisfactory and final solution to the problem of exposure to friable asbestos is to remove and dispose of the friable, asbestos-containing material. Thus, in the interest of health and safety, and in compliance with Federal, state, local and NASA regulations, topmost priority was given to the removal of friable asbestos from the GDSCC.

In December 1987, Engineering-Science, Inc. (E-S), Pasadena, California, submitted a Preliminary Engineering Report (PER) to JPL that dealt with the removal of friable asbestos from 10 buildings/structures at the GDSCC.

The 10 buildings scheduled for asbestos removal are: Echo Site (5 buildings: G-21, G-23, G-26, G-33 and G-38); Venus Site (G-51); Microwave Test Facility (G-72); Mars Site (G-86); and Mojave Base Site (2 buildings: M-6 and M-9).

During the actual asbestos-abatement work, friable asbestos also was removed from three additional buildings/structures: Echo Site (2 buildings: G-22 and G-27), and Venus Site (G-58).

In addition, the PER submitted by E-S dealt with the removal and replacement of three, liquid-propane fired, asbestos-fitted boilers in the following buildings: Echo Site (G-26 and G-38) and Microwave Test Facility (G-72). The friable asbestos and fiberglass insulation of the boilers' pipes and fittings were to be replaced with both black foam-rubber insulation (Armaflex) and with new, colorless fiberglass insulation.

The PER was prepared by E-S, following a site visit to the GDSCC in August 1987. The PER also was prepared in accordance with the "Preliminary Engineering for NASA Facility Project" contained in NASA Management Instruction (NMI 7330.2A) effective August 8, 1975.

This present volume, dealing with the removal of friable asbestos from the GDSCC, is an expanded JPL-version of the above mentioned PER. A separate volume in this ongoing series of Goldstone Environmental Projects, dealing with the GDSCC management of non-friable asbestos (vinyl asbestos floor tiles, roofing materials, and transite board for walls and pipes) may be issued in the future.

B. GENERAL COMMENTS

1. Condition of Asbestos-Containing Pipe Coverings at the GDSCC Before the Asbestos-Abatement Program

Much of the friable asbestos-containing insulation at the GDSCC did not appear to be an immediate health hazard. There was some deteriorated or damaged friable asbestos-containing insulation that could be a source of air-borne asbestos fibers in some areas. All the asbestos insulation, however, did present a substantial health hazard if it were disturbed. Most of the fittings and pipes that were insulated with friable asbestos-containing insulation were more than 25 years old. Whenever this equipment would require maintenance, the friable asbestos insulation would have to be removed to permit access. This would expose maintenance personnel and other building occupants to the hazard of asbestos fibers. Unfortunately, maintenance of the equipment could not be done without first removing the friable asbestos insulation.

2. Condition of Boilers at the GDSCC Before the Asbestos-Abatement Program

The condition of the boilers examined ranged from fair to poor. Most were serviceable but only with a substantial maintenance effort. This could be hazardous because maintenance workers would be exposed to the friable asbestos insulating materials in the boilers during their maintenance activities. Because these boilers are more than 20 years old, and because most commercial boilers have a useful life of 20 to 30 years, the need for a replacement of these boilers was indicated not only because of the asbestos-abatement program, but also because of mechanical safety and energy considerations.

C. ASBESTOS-ABATEMENT ALTERNATIVES THAT WERE CONSIDERED IN LIEU OF AN ASBESTOS-ABATEMENT PROGRAM THAT REMOVED ALL FRIABLE ASBESTOS FROM PIPE INSULATION AND BOILERS

Four alternative procedures were considered instead of an asbestos-abatement program to remove all friable asbestos materials from pipe insulation and from boilers that were to be replaced. The four considered alternatives are

1. Alternative One: No Action

This alternative would leave all friable asbestos intact, including asbestos in pipe insulation and in boilers. This alternative is incompatible with the JPL/NASA commitments both to ensure the health and safety of the GDSCC personnel, and to comply with all pertinent environmental regulations.

2. Alternative Two: Removal of Only the Friable Asbestos-Covered Pipe Fittings and Pipes During Boiler Removal and Replacement

This alternative would involve removal of the friable asbestos by glove bag as described in OSHA regulation 29 CFR 1926.58. Because the boilers themselves are suspected of containing asbestos-containing materials, it would not be practical to attempt small-scale removal of pipe coverings and fittings. Isolation barriers and engineering controls would be required for boiler disassembly and decontamination.

Because this alternative requires engineering practices more complex than those involved in total asbestos-abatement, and because this alternative is only a partial solution to the friable asbestos problem at the GDSCC, this alternative also was not recommended. As with Alternative One, this alternative also is incompatible with the JPL/NASA environmental commitments.

3. Alternative Three: Removal of Only the Friable Asbestos-Covered Pipe Fittings and Pipes During Boiler Removal and Replacement and Encapsulation of All Other Friable Asbestos

This alternative would remove all friable asbestos from all asbestos-covered pipe fittings and pipes that were accessible during boiler disassembly and decontamination. The remaining asbestos-covered pipe fittings, pipes, and other friable asbestos materials in each boiler room that were not associated with the boilers would be left in place and encapsulated before the asbestos-removal workers would leave the area. Damaged pipe fittings or pipe coverings would be repaired and left in place. All remaining pipe fittings and pipes would be properly identified as containing friable asbestos with distinctive coloring and asbestos warning stickers. Damaged pipe fittings in the air-handling or mechanical rooms would be repaired in place or removed using glove bags and mini-shrouds. The remaining friable asbestos-containing pipe fittings and pipe coverings would be identified and asbestos warning stickers affixed.

As with Alternative Two, this alternative is only a partial solution to the friable asbestos problem at the GDSCC. Future exposure to asbestos fibers at the GDSCC would remain a distinct possibility. Thus, Alternative Three also was not recommended.

4. Alternative Four: Complete Removal of Friable Asbestos From Pipe Insulation and Boilers at the GDSCC

This alternative would remove all friable asbestos from all pipe fittings and pipe coverings from the buildings/structures at the GDSCC. This would provide a safe work area for all mechanical workers and building occupants and would eliminate the danger of future exposure to asbestos fibers by maintenance personnel. Boilers at the GDSCC would be disassembled within asbestos-containment barriers to determine the extent of asbestos-containing materials in each boiler. The internal design of each boiler would determine how it could be disposed. If a boiler could be decontaminated, it could be disposed of as conventional waste. When work areas are determined to be clean by a final air monitoring test (a level of 0.01 asbestos fibers/cubic centimeter or less), mechanical workers would remove existing boilers and

install the new equipment in a more efficient manner without danger of disturbing any asbestos-containing material that would have been left in place if Alternative One, Two, or Three were implemented.

This alternative is compatible with the JPL/NASA commitments both to ensure the health and safety of the GDSCC personnel, and to comply with all pertinent environmental regulations. Although complete removal of friable asbestos is initially more costly than other asbestos-abatement procedures, most asbestos-abatement experts believe that complete removal of friable asbestos is the only final solution to the problem of asbestos exposure. It is the only alternative that can ensure that future exposures to asbestos fibers will not occur.

Thus, total removal of all pipe coverings provides the most practical method of asbestos abatement. With no remaining friable asbestos in boiler rooms, mechanical rooms, Building M-9 generator room, and Building M-6 rooftop units, the risk of future asbestos exposure is eliminated. The ease of access to each work area allows total isolation and engineering controls as required by OSHA to permit equipment installation in a manner that will not affect the health and safety of the building occupants.

D. DETAILS CONCERNING TOTAL FRIABLE-ASBESTOS ABATEMENT

1. General Considerations

Each asbestos removal project required specific, careful planning and coordination between site personnel and the various contractors. The actual method(s) selected for asbestos removal were dependent on the nature of the asbestos-containing material in place, the ability to regulate heating, ventilating and air conditioning (HVAC) and other utilities at each location, the need to maintain the service of each facility for Goldstone missions, and to ensure the safety of the asbestos-removal crew and Goldstone employees.

The limited space in each boiler room increased the difficulty of working near asbestos-containing pipe coverings without disturbing them. Total removal was done by small crews in each room in nearly the same time it would take to remove some fittings and repair or encapsulate others. Because other pipe coverings not identified as containing asbestos (fiberglass) would be difficult to protect during removal procedures, they also were removed and disposed of as contaminated waste.

Complete removal of all asbestos-containing materials, and non-asbestos-containing pipe coverings and fittings was done with glove bags and mini-shrouds. If properly used, glove bags and mini-shrouds protect asbestos workers during removal operations and eliminate the emission of airborne asbestos fibers that could contaminate mechanical and electrical equipment as well as other areas in the asbestos-containing buildings.

The asbestos removal and boiler replacement activities were scheduled during times that caused the least disruption of Goldstone activities. Proper respirator selection and use protected workers from asbestos fibers in the work area. Isolation barriers and engineering controls protected workers, occupants, and the environment during asbestos-removal operations.

2. Air Monitoring

Continuous air monitoring before and during friable asbestos removal, and final air monitoring before each area is released, ensured the safety of all personnel in or around the enclosed asbestos work areas. A final asbestos fiber level of 0.01 f/cc or less is generally accepted as "clean." Each asbestos work area was required to be at or below 0.01 f/cc before plastic isolation enclosures were torn down, before worker decontamination facilities and equipment cleaning rooms were dismantled, and before negative-air, HEPA-equipped fan units were shut down. Areas that did not meet the 0.01 f/cc requirement were re-cleaned until they did. As an added measure of protection, encapsulant was applied to all surfaces that previously contained friable asbestos after the friable asbestos was removed, but before final air monitoring.

3. Duties and Responsibilities of the Friable Asbestos Abatement Contractor

The asbestos removal contractor was required to:

- a. Provide a safe working environment for workers during all phases of the project.
- b. Make all necessary notifications to regulatory agencies, such as OSHA and EPA.
- c. Provide all required training procedures and orientation information for asbestos removal workers and Goldstone personnel.
- d. Obtain all required permits for the transport and disposal of asbestos and provide verification that all asbestos containing materials had been properly transported and disposed.
- e. Provide specific asbestos abatement insurance.
- f. Provide a detailed written plan of action for asbestos removal and methods of coordination with other operations.
- g. Provide proper worker protection, decontamination facilities, and any special equipment required for work on the asbestos-abatement project. An example is a mobile decontamination facility, self-contained with proper showers, clean room, and water filtration. Precautions to avoid heat stress also must be taken. This includes ice vests, an air-conditioned break area, and medical personnel on-site to monitor workers.
- h. Prepare a detailed health and safety plan for the work.
- i. Provide experienced, certified workers.
- j. Provide medical examinations for workers.
- k. Provide emergency exit plans.

- l. Detail emergency spill procedures and ensure that the required equipment and personnel will be available at all times.
- m. Perform all air monitoring required for the duration of the project.
- n. Prepare detailed, written daily documentation of the project and keep copies on-site at all times.
- o. Repair any damage to facility equipment or structures that may occur during asbestos removal procedures.

Under no circumstances was any asbestos-abatement method, procedure, or action accepted that was in violation of any applicable Federal, state, local, or NASA regulations.

E. REPLACEMENT OF BOILERS AT THE GDSCC THAT CONTAINED OR WERE ASSOCIATED WITH FRIABLE ASBESTOS

The replacement of existing Bryan boilers with new models not only removed friable asbestos but also eliminated any future asbestos exposure hazard to workers during boiler maintenance work, and increased the efficiency of operation of the boilers. The installation of new gas boilers is cost effective, because gas connections already are in place at each existing boiler location; exhaust flues already penetrate the roofs; and related controls and equipment are similar between the old and new boilers. Future energy costs will be reduced by replacing the existing boilers with the new, equivalent Bryan gas-fired boilers.

Maintenance and operating manuals for the newly installed Bryan gas-fired boilers were provided by the manufacturer.

F. ACTUAL IMPLEMENTATION OF THE FRIABLE ASBESTOS-ABATEMENT PROGRAM AT THE GDSCC

When Jenkin Construction Company, Long Beach, California, was retained by JPL to oversee the work necessary to correct environmental problems at the GDSCC, it also was placed in charge of the friable asbestos-abatement program. Engineering-Science, Inc. (E-S), Pasadena, California, was selected as the engineering firm to oversee the implementation of the friable asbestos-abatement program.

In turn, K&D West, Inc., Torrance, California, was retained by E-S to conduct air monitoring and related inspection services during the removal of friable asbestos-containing materials.

A report, dated April 19, 1989, and entitled "Air Monitoring and Related Safety and Health Inspections Conducted During Asbestos Removal at Goldstone Deep Space Communications Complex, Mojave Desert, California," was prepared by K&D West, Inc., for Engineering-Science, Inc. The report, which is an account of the specific techniques used in air monitoring and related inspection services performed during the removal of friable asbestos from the GDSCC, is presented in Appendix A of Friable Asbestos Abatement Supplemental Records, JPL D-7450 (internal document), Jet Propulsion Laboratory, Pasadena, California.

Friable asbestos debris was removed from the GDSCC by National Environmental Corporation, Downey, California (US EPA ID No. CAD 981438146) and transported for disposal to a hazardous material landfill in Joseph City, Arizona. The manifest for the transport and disposal of the friable asbestos debris is presented in Appendix H of this document.

Table 11 describes a chronological summary of the friable asbestos-abatement program carried out at the GDSCC.

G. BUILDING-BY-BUILDING DESCRIPTION OF FRIABLE ASBESTOS ABATEMENT AT THE GDSCC

Table 12 lists the 10 buildings/structures at the GDSCC that had various rooms from which friable asbestos was removed.

The organization of this part of the present volume involves a brief description of the work done within a specific building to remove all friable asbestos, followed by a detailed description of the various uses of asbestos that were found within that building, and a floor plan of the building.

Reference to a particular use of asbestos within a building is given by a two-letter reference number (e.g., AA). The first letter of the reference key is as follows:

- A = asbestos found in pipe wrapped insulation.
- B = asbestos found in exterior siding or roof material.
- C = asbestos found in wall structures or partitions.
- D = asbestos found in plenum, attic or crawl space.
- E = asbestos found in ceilings or ceiling structures.
- F = asbestos found in steam vessels.
- G = asbestos found in flooring materials.
- H = asbestos found in miscellaneous material.

The first letter of a reference number represents the type of asbestos use. The second letter represents the order in which the asbestos was sampled. Thus, the reference number AA is pipewrap insulation and the first sample taken for analysis. Similarly, the reference number GD is that of floor tile and represents the fourth sample taken for analysis (since G represents floor tile and D is the fourth letter of the alphabet).

A description of the friable asbestos-abatement work in the various buildings at the GDSCC is as follows:

Table 11. Chronology of Work Involved in Abatement/Removal of Friable Asbestos at the GDSCC*

1988

- 21 Dec. Completed baseline air sampling and monitoring for asbestos fibers at:
Echo Site: Bldg. G-38: Rooms 110, 115, 105, 129, 118 and 131
 Bldg. G-21: Rooms 127, 128, 113, 102, 126 and 127
- 22 Dec. Completed baseline air sampling and monitoring for asbestos fibers at:
Echo Site: Bldg. G-26: Rooms 127, 109, 110, 112, 119 and exterior
Mars Site: Bldg. G-86: Rooms 101, 104, 200, 201 and exterior
Mojave Base Site: Bldg. M-9: Rooms 106, 108 and exterior
Microwave Test Facility: Bldg. G-72: Rooms 103, 113, 112, 111, 110 and exterior
- 28 Dec. Completed baseline air sampling and monitoring for asbestos fibers at:
Echo Site: Bldg. G-23: Rooms 107, 108, 110, 115, 117 and exterior
 Bldg. G-33: Rooms 131, 133, 134, 139, 140, 141 and 146
- 29 Dec. Completed baseline air sampling and monitoring for asbestos fibers at:
Venus Site: Bldg. G-51: Rooms 101, 102, 106, 107, 108 and exterior
 This completed the baseline air sampling procedures for asbestos fibers at the GDSCC.

1989

- 27 Feb. Echo Site: Asbestos-abatement crew began preparations for removal of friable asbestos from Bldg. G-23.
- 28 Feb. Echo Site: Completed removal of friable asbestos from Rooms 107 and 108 of Bldg. G-23. Air samples taken and room sealed until results were available.
General: JPL and GDSCC personnel agreed to a working schedule for the asbestos-abatement crew of 4 days/week and 10 hr/day, Monday through Thursday.
- 1 Mar. Echo Site: Because some of the friable asbestos on some of the pipes and fittings in Bldg. G-23 was strongly consolidated, the asbestos-abatement crew began asbestos removal by scraping.
General: Engineering-Science, Inc., the engineering overseer of the asbestos-abatement program, not only will take air samples, but also will inspect and monitor the work of the asbestos-abatement crew.

Table 11 (continued)

- 2 Mar. Echo Site: Asbestos-abatement crew also completed removal of the friable asbestos thermal insulation covering the Fire, Water, and Supply Line outside of the Electric Fire Pump Building (G-22). After passing a visual inspection, the pipes were encapsulated. The asbestos-abatement Contractor was asked to supply the Material Safety Data Sheets (MSDS) for the three encapsulation materials used. The Contractor also was informed that no encapsulation work was to be done until after the work had passed a visual inspection. Echo Site: Rooms 107 and 108 of Bldg. G-23 passed visual inspection following the asbestos removal procedure. Air sampling indicated fewer asbestos fibers/cc than stipulated by regulations.
- 6 Mar. Echo Site: A final air sampling of Rooms 107 and 108 of Bldg. G-23 indicated that the concentrations of asbestos fibers in air were below acceptable levels.
Mojave Base Site: Asbestos abatement began in Bldgs. M-6 and M-9.
- 7 Mar. Mojave Base Site: Using glove bags, the asbestos-abatement crew removed asbestos and fiberglass insulation from piping in Bldg. M-6. Abatement work, however, did not pass visual inspection.
- 14 Mar. Echo Site: Asbestos-abatement work at the Office/Storage Bldg. (G-27) passed visual inspection.
Asbestos-abatement work completed at Bldg. G-21.
Venus Site: Asbestos-abatement work at the Hydrochemical/Transmitter Bldg. (G-58) passed visual inspection.
Mojave Base Site: Asbestos-abatement work completed at Bldg. M-9.
- 15 Mar. General: Asbestos-abatement Contractor informed that, with the exception of glove-bagging work and use of respirators, no abatement work could proceed without the presence of a Contractor's hygienist.
- 16 Mar. Venus Site: Asbestos-abatement work at Bldg. G-51 passed visual inspection and air-sampling tests.
Mojave Base Site: Asbestos-abatement work at Bldg. M-9 passed visual inspection and air-sampling tests.
- 20 Mar. Microwave Test Facility: Friable asbestos removed from Bldg. G-72. Work passed visual inspection.
Echo Site: Began removal of friable asbestos and thermal insulation from Engineering/Communications Bldg. (G-33).
- 21 Mar. Microwave Test Facility: Bldg. G-72 passed air-sampling tests after asbestos removal.
Echo Site: Room 127 of Bldg. G-21 passed air-sampling tests, but Room 128 did not. Contractor had to return to further clean room's environs.
- 22 Mar. Echo Site: Completed friable asbestos removal and thermal insulation from Bldg. G-33. Work passed visual inspection.
All rooms of Bldg. G-21 passed air-sampling tests.
Minor cut injury to an asbestos-abatement worker.

Table 11 (continued)

- 23 Mar. Echo Site: Thermal insulation removal from Room 115 of the Net Laboratory/Maintenance Bldg. (G-38) passed visual inspection.
- 27 Mar. Echo Site: All rooms of Bldg. G-33 passed visual inspection and air-sampling tests.
Room 115 of Bldg. G-38 passed air-sampling tests.
Mars Site: Asbestos abatement began at operations Support Bldg. (G-86).
- 28 Mar. Mars Site: Asbestos-abatement work at Bldg. G-86 passed both visual inspection and air-sampling tests.
Echo Site: Friable asbestos and thermal insulation removed from all rooms of Bldg. G-38. After passage of visual inspection, the cleaned pipes were encapsulated.
Friable asbestos and thermal insulation removal was begun in Operations Control Bldg. (G-26).
- 29 Mar. Echo Site: Bldg. G-38 passed air-sampling tests.
After removal of friable asbestos and thermal insulation from Bldg. G-26, and passage of visual inspection, the cleaned pipes were encapsulated.
- 30 Mar. Echo Site: Bldg. G-26 passed the air-sampling tests.
General: Contractor removed the boilers from Bldgs. G-26 and G-38 (Echo Site) and G-72 (Microwave Test Facility). The boilers were glove-bagged, wrapped in plastic and placed in dumpsters provided by the Contractor that are specific for asbestos debris. The dumpsters were hauled away from the GDSCC. Copies of the Manifests for the transport of the boilers are retained by the GDSCC Environmental Department.
- 10 Apr. Echo Site: Re-insulation of pipes began in Bldgs. G-21, G-22, G-23, G-26, G-27, G-33 and G-38.
- 11 Apr. Microwave Test Facility: New boiler for Bldg. G-72 positioned into place.
- 14 Apr. Echo Site: New boilers for Bldgs. G-26 and G-38 positioned into place.
- 19 Apr. Mojave Base Site: After pipes in Bldg. M-6 passed visual inspection, they were re-insulated.
- 20 Apr. Venus Site: Re-insulation of pipes in Bldgs. G-51 and G-58.
- 3 May Re-insulation work continued at Bldgs. G-33 and G-38 (Echo Site) and at Bldg. G-72 (Microwave Test Facility).
- 4 May Representatives of the manufacturers of the three newly installed water boilers visited the GDSCC sites to test the boilers.
Re-insulation work continued at Bldgs. G-26 and G-38 (Echo Site), Bldg. G-72 (Microwave Test Facility), and Bldg. M-9 (Mojave Base Site).

Table 11 (continued)

8 May	<u>Microwave Test Facility:</u> Completed re-insulation of boiler-room piping in Bldg. G-72.
11 May	Completed piping re-insulation in Bldgs. G-21, G-22, G-23, G-26, G-27 and G-33 (Echo Site) and Bldgs. G-51 and G-58 (Venus Site). Inspections revealed the workmanship and materials to be satisfactory.

*This chronology is based upon Daily Field Reports written by Engineering-Science, Inc., Pasadena, California, the Resident Engineer that represented JPL.

Table 12. Summary of Asbestos-Containing Materials Survey Information at the GDSCC

Location of Asbestos	Type of Asbestos	Condition	Estimated Quantity*
<u>ECHO SITE</u>			
BLDG. G-21			
Room 127	Boiler exhaust flue pipe and fitting	Some physical damage	20 fittings, 80 L/F pipe covering
Room 128	Pipe fittings and related pipe covering	Some physical damage	20 fittings, 10-ft boiler flue, 100-L/F pipe covering
BLDG. G-23			
Room 107	Pipe and fitting insulation, boiler flue, expansion tank insulation, water heater exhaust flue insulation	Some physical damage	35 fittings, 80-L/F pipe covering, 10-ft boiler flue. Tank is 3 ft wide by 6 ft tall. Exhaust flue is 6 in. in diameter and 10 ft long
Room 108	Pipe and fitting insulation	Generally good	40 fittings, 3-L/F pipe covering
BLDG. G-26			
Room 108	Pipe and fitting insulation	Some physical damage	20 fittings, 100-L/F pipe covering
Room 109	Pipe and fitting insulation	Some physical damage	8 fittings
Room 110	Pipe and fitting insulation, flue	Some physical damage	15 fittings, 80-L/F pipe covering, 8-in. boiler flue, 8 L/F
BLDG. G-33			
Room 133	Pipe and fitting insulation, boiler exhaust flue	Some physical damage	20 fittings, 100-L/F pipe covering, 8-in. boiler flue, 10 L/F

Table 12. Summary of Asbestos-Containing Materials Survey Information at the GDSCC (Continued)

Location of Asbestos	Type of Asbestos	Condition	Estimated Quantity*
<u>ECHO SITE</u> (Continued)			
Room 134	Pipe and fitting insulation	Some physical damage	35 fittings, 100-L/F pipe covering (w/ACM and fiberglass)
Room 138	Pipe and fitting insulation	Fair to good	20 fittings, 80-L/F pipe covering
Room 139	Pipe and fitting insulation (pipe mostly fiberglass but may be contaminated)	Some physical damage	80 fittings, 130-L/F pipe covering
Room 140	Pipe and fitting insulation, boiler flue	Some physical damage	50 fittings, 200-L/F pipe covering, 10-in. boiler flue
Room 142	Pipe and fitting insulation, boiler flue	Some physical damage	20 fittings, 80-L/F pipe covering, 8-in. boiler flue, 15 L/F
<u>BLDG. G-38</u>			
Room 108	Pipe and fitting insulation	Some physical damage	16 fittings
Room 113	Pipe and fitting insulation	Some physical damage	15 fittings, 30-L/F pipe covering (fiberglass and ACM)
Room 115	Pipe and fitting insulation	Some physical damage	35 fittings
Room 129	Pipe and fitting insulation, boiler exhaust flue	Some physical damage	20 fittings, 100-L/F pipe covering, 8-in. boiler flue, 10 L/F

Table 12. Summary of Asbestos-Containing Materials Survey Information at the GDSCC (Continued)

Location of Asbestos	Type of Asbestos	Condition	Estimated Quantity*
<u>VENUS SITE</u>			
BLDG. G-51			
Room 107 (boiler)	Pipe and fitting insulation, boiler exhaust flue	Some physical damage. Boiler exhaust flue in poor condition	12 fittings, 20-L/F pipe covering, 6-in. boiler flue, 5 L/F
Room 107 (air handler electrical)	Pipe and fitting insulation	Some physical damage	45 fittings, 150-L/F pipe covering
<u>MICROWAVE TEST FACILITY SITE</u>			
BLDG. G-72			
Room 110	Pipe and fitting insulation, boiler exhaust flue	Some physical damage	14 fittings, 50-L/F pipe covering, 6-in. boiler flue, 10 L/F
Room 111	Pipe and fitting insulation	Some physical damage	25 fittings, 2 or 3 in. diameter, 15 fittings, 4 to 6 in. diameter, 80-L/F pipe coverings
<u>MARS SITE</u>			
BLDG. G-86			
Mechanical Room	Pipe and fitting insulation, cementitious materials	Some physical damage	35 fittings, 100-L/F pipe covering
<u>MOJAVE BASE STATION</u>			
BLDG. M-6			
Roof units	Pipe and fitting insulation, roof flashing material	Good	40 fittings, 80-L/F pipe covering, 4 roof penetrations

Table 12. Summary of Asbestos-Containing Materials Survey Information at the GDSCC (Continued)

Location of Asbestos	Type of Asbestos	Condition	Estimated Quantity*
<u>MOJAVE BASE STATION</u> (Continued)			
BLDG. M-9			
Generator room and outside of building continuation	Generator exhaust lagging metal jacketed	Small amount of physical damage	80 L/F, 10 to 12 in. diameter, 2 in. thick

*Linear feet (L/F) of pipe insulation includes asbestos and fiberglass insulation.

1. Echo Site: A plot plan of the Echo Site is depicted in Figure 6.

- a. Building G-21 (Figure 7).

Building G-21 provides office space for Systems Engineering and Administration personnel and also houses the GDSCC's cafeteria. Space is also available for conferences, reproduction services, and restrooms. Except during meal-service periods and visits by outside personnel, the building is occupied by about 20 people per work shift, with five shifts per week.

Building G-21 has a great amount of non-friable asbestos-containing floor tiles. An illustration of typical non-friable, asbestos-containing floor tiles in Building G-21, and in many other buildings at the GDSCC, is shown in Figure 8.

Mechanical Room 127 contained pipe fittings that were insulated with friable asbestos and fiberglass. These were removed and replaced by Armaflex and new fiberglass insulation.

Figure 9 depicts the friable asbestos-containing pipe-lagging in Room 127 of Building G-21 BEFORE the asbestos-abatement program, while Figure 10 shows the re-insulated pipes AFTER the friable asbestos pipe lagging was removed.

A Bryan Model 313 W Boiler is located in Room 128 (Figure 11). Approximately 100 linear feet of fiberglass insulation on the piping associated with the boiler was replaced along with the friable asbestos insulation that covered the pipe fittings and boiler exhaust flue. Of course, heating and mechanical equipment were shut down during the asbestos-abatement work.

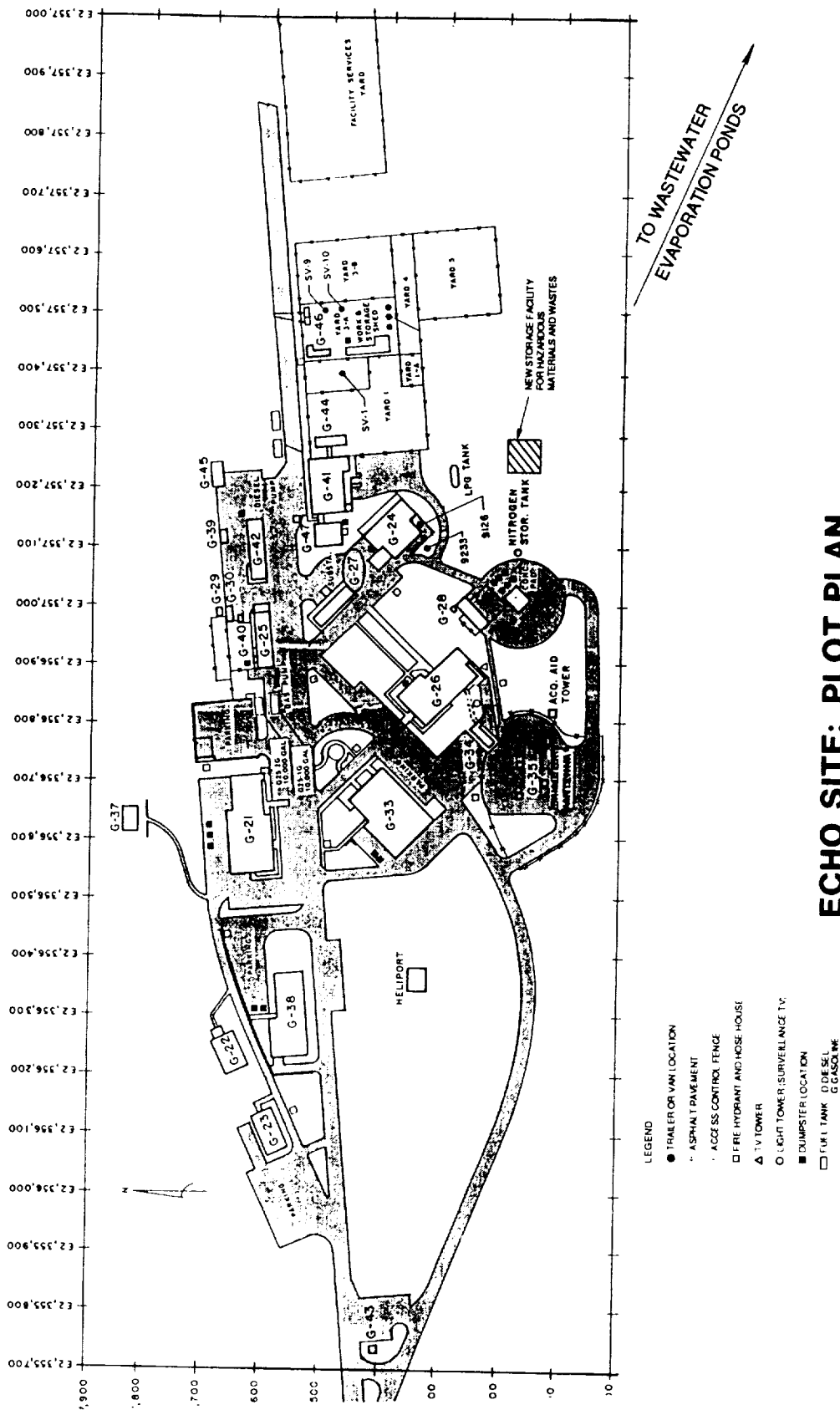


Figure 6. Echo Site: Plot Plan

Building G-21 (Echo Site)

GENERAL BUILDING INFORMATION

Map grid location: N 657,650/E 2,356,600
Construction date: 1958
Building type: Cement/cement block
Number of floors: 1
Total floor area (SF): 11,860
Building use: ADMINISTRATION AND CAFETERIA
Summary of asbestos use(Bldg G-21): Floors, pipelines (interior)

PIPELINES (Reference AA)

Location of pipes: RM 128
Pipe diameter with insulation (in.): 4.00
Insulation thickness (in.): 0.750
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW HAS HARD CEMENTITIOUS MATERIAL WITH SOME ADDITIONAL USE EXTENDING AWAY FROM THE ELBOW. SEE FIGURE 7.

PIPE LINES (Reference AC)

Location of pipes: RM 128
Pipe diameter with insulation (in.): 6.00
Insulation thickness (in.): 0.250
Approximate pipe length (LF): 6.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures

Building G-21 (Echo Site) (Cont'd)

Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: HEATER EXHAUST VENT FLUE COVERING. SEE FIGURE 7.

PIPE LINES (Reference AD)

Location of pipes: RM 128
Pipe diameter with insulation (in.): 4.00
Insulation thickness (in.): 0.750
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: HARD CEMENTITIOUS MATERIAL AT ELBOW. SEE FIGURE 7.

PIPE LINES (Reference AE)

Location of pipes: RM 127
Pipe diameter with insulation (in.): 4.00
Insulation thickness (in.): 0.750
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures

Building G-21 (Echo Site) (Cont'd)

Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW OF HARD CEMENTITIOUS MATERIAL WITH SOME ADDITIONAL USE EXTENDING AWAY FROM THE ELBOW. SEE FIGURE 7.

PIPELINES (Reference AG)

Location of pipes: RM 127
Pipe diameter with insulation (in.): 4.00
Insulation thickness (in.): 0.750
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW OF HARD CEMENTITIOUS MATERIAL WITH SOME ADDITIONAL USE EXTENDING AWAY FROM THE ELBOW. SEE FIGURE 7.

FLOORING MATERIALS (Reference GA)

Asbestos-bearing material found in: 12 X 12 in. TILE
Friable or non-friable: Non-friable
Surface area (SF): 1270
Thickness of material (in.): 0.125
Estimated volume (CF): 13
Condition of material: Undisturbed
Types of coatings present: None
Building use near asbestos: Office/administration
Work population: 1-10
Ventilation: General forced air
Accessibility to area: Within normal reach

Building G-21 (Echo Site) (Cont'd)

Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: Yes
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: 12 X 12 in. WHITE TILE WITH SOME CARPET OVERLAY. SEE FIGURE 7.

FLOORING MATERIALS (Reference GB)

Asbestos-bearing material found in: 9 X 9 in. TILE
Friable or non-friable: Non-friable
Surface area (SF): 153
Thickness of material (in.): 0.062
Estimated volume (CF): 1
Condition of material: Undisturbed
Types of coatings present: None
Building use near asbestos: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: 9 X 9 in. WHITE TILE WITH GRAY STREAKS. SEE FIGURE 7.

FLOORING MATERIALS (Reference GC)

Asbestos-bearing material found in: 9 X 9 in. TILE
Friable or non-friable: Non-friable
Surface area (SF): 7700
Thickness of material (in.): 0.125
Estimated volume (CF): 80
Condition of material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: None
Building use near asbestos: Office/administration
Work population: 11-50
Ventilation: General forced air
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures

Building G-21 (Echo Site) (Cont'd)

Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)

Presence of sensitive equipment: Yes

Suggested abatement timing: At time of demolition

Suggested abatement method: Removal

Suggested airborne monitoring: None required under normal conditions

Comments: 9 X 9 in. GREEN TILE WITH STREAKS LIKE THOSE USED IN BUILDING G-26. SEE FIGURE 7.

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH



Figure 8. Typical Asbestos-Containing Floor Tiles in Building G-21
and in Many Other Buildings at the GDSCC

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

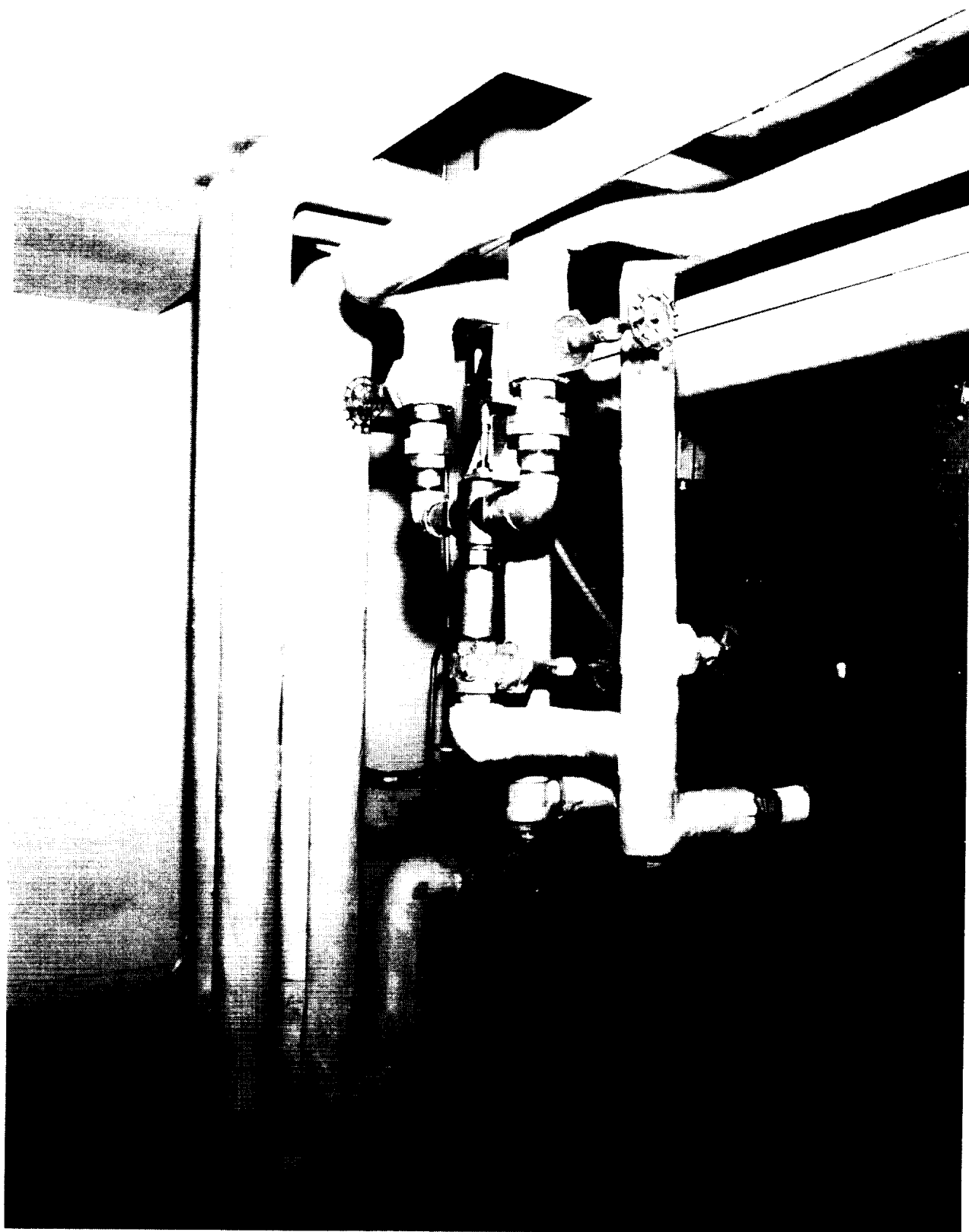


Figure 9. Echo Site: Building G-21. BEFORE Asbestos Removal.
Mechanical Equipment Room 127 With Pipe Lagging
Containing Friable Asbestos.

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

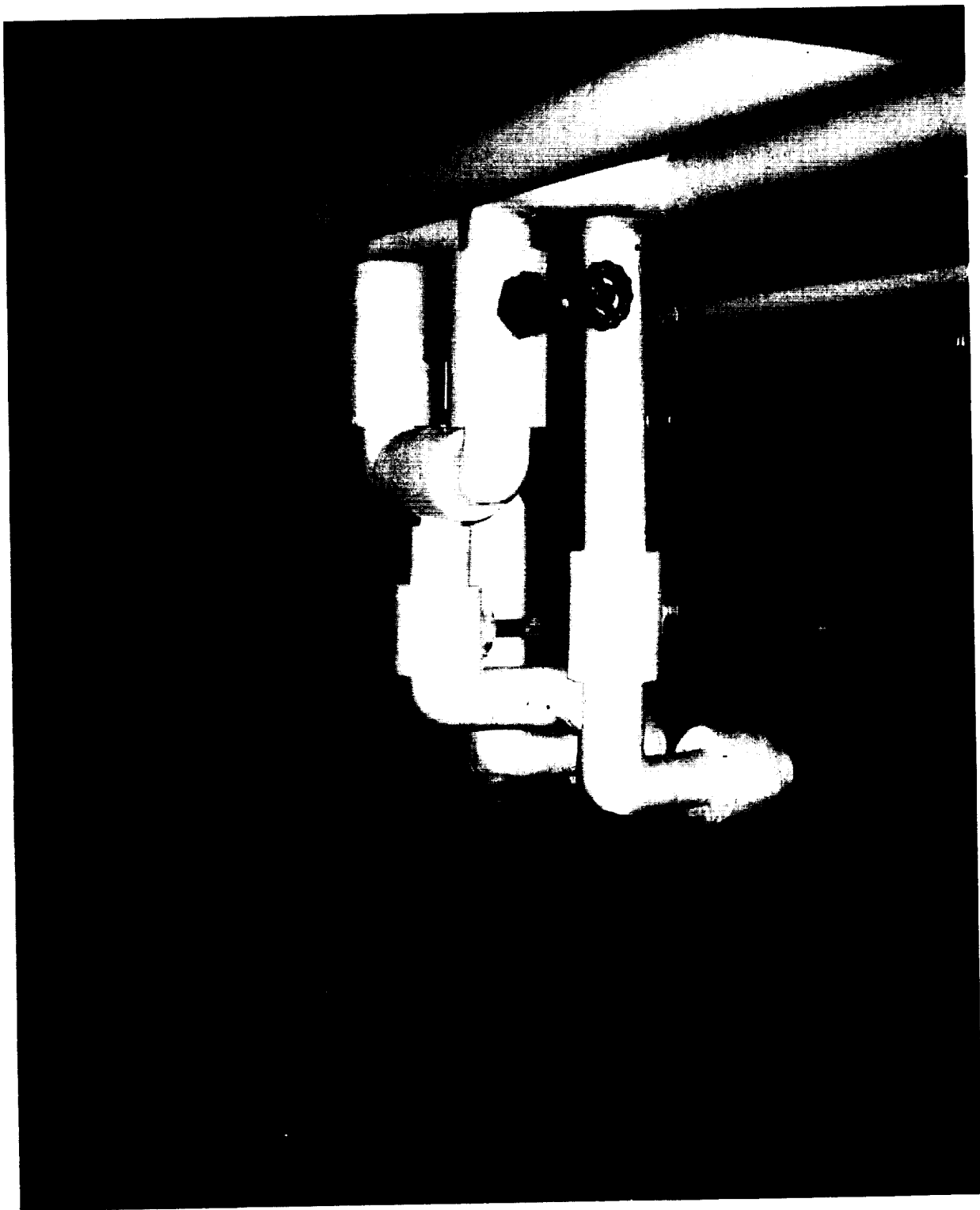


Figure 10. Echo Site: Building G-21. AFTER Asbestos-Removal. Mechanical Equipment Room 127 With Friable Asbestos. Pipe Lagging Removed and Replaced With Armaflex and Fiberglass Insulation.

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

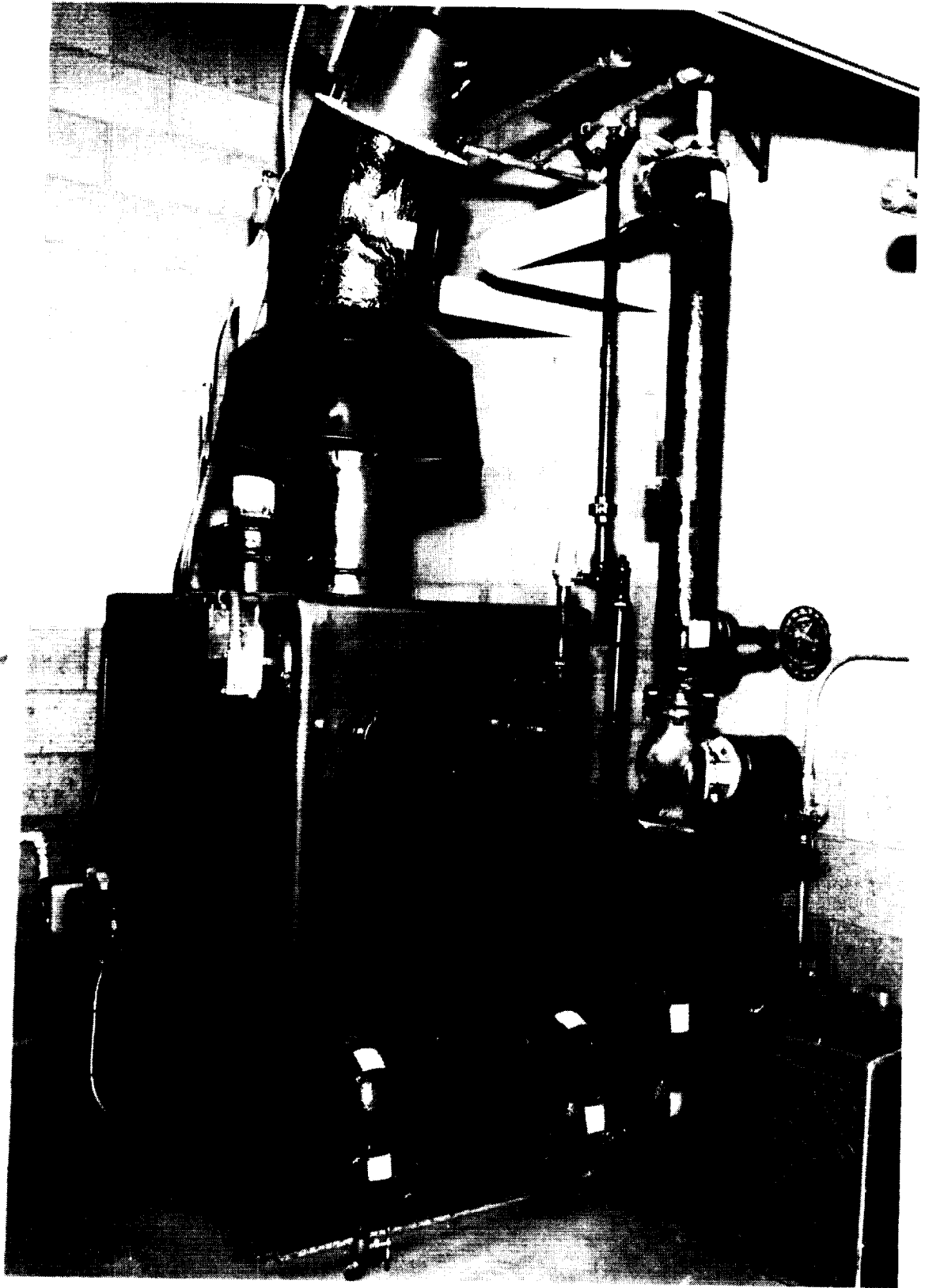


Figure 11. Echo Site: Building G-21, Boiler Room 128 Showing Typical Pipe Lagging Containing Friable Asbestos.

Fortunately, both Rooms 127 and 128 are physically separated and isolated from the office and kitchen areas, and also are easily accessible from the outside of the building. Thus, asbestos abatement was carried out by the asbestos-abatement crew without having to move through the kitchen or office areas or affecting the health and safety of the building's occupants.

b. Building G-23 (Figure 12)

Building G-23, the Dormitory Building, provides sleeping rooms, showers, and office space for visitors to GDSCC.

A Bryan Model C-8W boiler is located in Boiler Room 107. Friable asbestos-containing materials and fiberglass used to insulate the pipe fittings, the pipes, the boiler exhaust flue, expansion tank, and hot water heater exhaust flue were removed and replaced.

Mechanical Room 108 contained pipe fittings and pipe that were insulated with friable asbestos and fiberglass. These were removed and replaced by Armaflex and new fiberglass insulation.

Because of their physical separation and isolation by walls, along with ready access from the outside, the boiler and mechanical rooms of Building G-23 had their friable asbestos and fiberglass insulations removed and replaced by non-asbestos containing insulation, without affecting the health and safety of the building's occupants. Of course, heating/cooling and mechanical equipment were shut down during the asbestos-abatement work.

c. Building G-26 (Figures 13 and 14)

Building G-26, the Control Building, contains the Operations Control Center, the Timing Standards Laboratory, and both office and storage space.

Mechanical Room 101A has a Bryan Model 3095-T Boiler that had been re-insulated with non-asbestos before the present asbestos-abatement program began.

A Bryan Model CL-16W Boiler, located in Room 130, was replaced by a new and equivalent Bryan Hot Water Gas-Fired Boiler Model F250WAG. Insulation on pipes, pipe fittings, and flue exhausts also were removed and replaced with non-asbestos containing insulation.

Because of its physical separation and isolation by walls, along with ready access from the outside, the boiler and its friable asbestos-containing insulation in Room 130 were removed and replaced without impinging upon the health and safety of the building's occupants. Of course, heating/cooling was shut down during the asbestos-abatement work.

d. Building G-33 (Figure 15)

Building G-33, the Engineering and Communications Building, provides space for offices, photographic laboratory equipment and computers.

Building G-23 (Echo Site)

GENERAL BUILDING INFORMATION

Map grid location: N 657,600/E 2,356,100
Construction date: 1958
Building type: Cement/cement block
Number of floors: 1
Total floor area (SF): 3120
Building use: DORMITORY
Summary of asbestos use (Bldg G-23): Floors, pipelines
(interior), steam vessels (interior)

PIPELINES (Reference AD)

Location of pipes: RM 108
Pipe diameter with insulation (in.): 4.00
Insulation thickness (in.): 0.75
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs,
tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing,
bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal
conditions

Comments: ELBOW HAS HARD CEMENTITIOUS MATERIAL. SEE FIGURE 12.

PIPELINES (Reference AF)

Location of pipes: RM 108
Pipe diameter with insulation (in.): 4.50
Insulation thickness (in.): 0.750
Approximate pipe length (LF): 2.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs,
tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder

Building G-23 (Echo Site) (Cont'd)

Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW OF HARD CEMENTITIOUS MATERIAL WITH SOME ADDITIONAL USE EXTENDING AWAY FROM THE ELBOW. SEE FIGURE 12.

PIPELINES (Reference AI)

Location of pipes: RM 107
Pipe diameter with insulation (in.): 6.00
Insulation thickness (in.): 0.500
Approximate pipe length (LF): 7.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: EXHAUST PIPE LAGGING. SEE FIGURE 12.

PIPELINES (Reference AK)

Location of pipes: RM 107
Pipe diameter with insulation (in.): 4.00
Insulation thickness (in.): 0.500
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural

Building G-23 (Echo Site) (Cont'd)

Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: HARD CEMENTITIOUS MATERIAL ON PIPING NEAR ELBOW. SEE FIGURE 12.

PIPELINES (Reference AM)

Location of pipes: RM 107
Pipe diameter with insulation (in.): 4.00
Insulation thickness (in.): 0.125
Approximate pipe length (LF): 45.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: HARD CEMENTITIOUS MATERIAL ON PIPING NEAR ELBOW. SEE FIGURE 12.

STEAM VESSELS (Reference FA)

Location of asbestos-bearing material: RM 107 Interior
Friable or non-friable: Friable
Diameter of vessel (ft): 3
Length of vessel (ft): 6.00
Thickness of material (in.): 1.000
Estimated volume of asbestos (CF): 6
Condition of material: Undisturbed
Types of coatings present: Cloth covering
Building use near asbestos: Industrial maintenance
Work population: None
Ventilation: Natural

Building G-23 (Echo Site) (Cont'd)

Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future (within 6 mo.)
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: BOILER ROOM ACCESSED FROM OUTSIDE AND IS IN A TIGHT SPACE.
SEE FIGURE 12.

FLOORING MATERIALS (Reference GA)

Asbestos-bearing material found in: 9 X 9 in. TILE
Friable or non-friable: Non-friable
Surface area (SF): 2443
Thickness of material (in.): 0.125
Estimated volume (CF): 25
Condition of material: Undisturbed
Types of coatings present: None
Building use near asbestos: Other
Work population: 1-10
Ventilation: General forced air
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: 9 X 9 in. BEIGE AND BROWN FLOOR TILE. ACTIVITY USE IS FOR A DORMITORY AND INFIRMARY. SEE FIGURE 12.

Building G-26 (Echo Site)

GENERAL BUILDING INFORMATION

Map grid location: N 657,300/E 2,356,900
Construction date: 1958
Building type: Cement/cement block
Number of floors: 1
Total floor area (SF): 11,508
Building use: CONTROL BUILDING
Summary of asbestos use (Bldg G-26): Floors, pipelines (interior),
boiler insulation, roofing material

PIPELINES (Reference AA)

Location of pipes: RM 109
Pipe diameter with insulation (in.): 3.75
Insulation thickness (in.): 0.50
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs,
tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing,
bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal
conditions

Comments: ELBOW OF HARD CEMENTITIOUS MATERIAL WITH SOME ADDITIONAL USE
EXTENDING AWAY FROM THE ELBOW. SEE FIGURE 13.

PIPELINES (Reference AC)

Location of pipes: RM 109
Pipe diameter with insulation (in.): 3.75
Insulation thickness (in.): 0.50
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs,
tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder

Building G-26 (Echo Site) (Cont'd)

Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW OF HARD CEMENTITIOUS MATERIAL WITH SOME ADDITIONAL USE EXTENDING AWAY FROM THE ELBOW. SEE FIGURE 13.

PIPELINES (Reference AE)

Location of pipes: RM 109
Pipe diameter with insulation (in.): 3.75
Insulation thickness (in.): 0.50
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW OF HARD CEMENTITIOUS MATERIAL WITH SOME ADDITIONAL USE EXTENDING AWAY FROM THE ELBOW. SEE FIGURE 13.

PIPELINES (Reference AG)

Location of pipes: RM 110
Pipe diameter with insulation (in.): 3.75
Insulation thickness (in.): 0.50
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage, (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10

Building G-26 (Echo Site) (Cont'd)

Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW OF HARD CEMENTITIOUS MATERIAL WITH SOME ADDITIONAL USE EXTENDING AWAY FROM THE ELBOW. SEE FIGURE 13.

PIPELINES (Reference AJ)

Location of pipes: RM 108
Pipe diameter with insulation (in.): 3.75
Insulation thickness (in.): 0.50
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW OF HARD CEMENTITIOUS MATERIAL WITH SOME ADDITIONAL USE EXTENDING AWAY FROM THE ELBOW. SEE FIGURE 13.

PIPELINES (Reference AL)

Location of pipes: RM 108
Pipe diameter with insulation (in.): 3.75
Insulation thickness (in.): 0.50
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance

Building G-26 (Echo Site) (Cont'd)

Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW OF HARD CEMENTITIOUS MATERIAL WITH SOME ADDITIONAL USE EXTENDING AWAY FROM THE ELBOW. SEE FIGURE 13.

WALL STRUCTURES/PARTITIONS (Reference CA)

Asbestos-bearing material found in: Wall structure
Friable or non-friable: Non-friable
Surface area (SF): 672
Thickness of material (in.): 0.75
Estimated volume of asbestos (CF): 42
Condition of material: Undisturbed
Types of coatings present: Coatings/encapsulants
Building use near asbestos: Casual or incidental
Work population: 1-10
Ventilation : General forced air
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: Yes
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: TAPE VAULT WALLS ARE IN GOOD CONDITION. MAINTAIN A GOOD PROTECTIVE COATING ON WALLS. SEE FIGURE 13.

FLOORING MATERIALS (Reference GB)

Asbestos-bearing material found in: 9 X 9 in. TILE
Friable or non-friable: Non-friable
Surface area (SF): 1
Thickness of material (in.): 0.125
Estimated volume (CF): 1
Condition of material: Undisturbed
Types of coatings present: None
Building use near asbestos: Office/administration

Building G-26 (Echo Site) (Cont'd)

Work population: 1-10
Ventilation: General forced air
Accessibility to area: Within normal reach
Obstructions to area: None
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: Yes
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: 9 X 9 in. LIGHT-GREEN TILE USED FOR REPLACEMENT. SEE FIGURE 13.

FLOORING MATERIALS (Reference GC)

Asbestos-bearing material found in: 9 X 9 in. TILE
Friable or non-friable: Non-friable
Surface area (SF): 1510
Thickness of material (in.): 0.125
Estimated volume (CF): 15
Condition of material: Undisturbed
Types of coatings present: None
Building use near asbestos: Office/administration
Work population: 1-10
Ventilation: General forced air
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: Yes
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: 9 X 9 in. LIGHT-GREEN TILE WITH WHITE STREAKS. PRIMARY FLOOR USED IN BUILDING. SEE FIGURE 13.

FLOORING MATERIALS (Reference GD)

Asbestos-bearing material found in: 9 X 9 in. TILE
Friable or non-friable: Non-friable
Surface area (SF): 320
Thickness of material (in.): 0.25
Estimated volume (CF): 7
Condition of material: Undisturbed
Types of coatings present: None
Building use near asbestos: Office/administration
Work population: 1-10

Building G-26 (Echo Site) (Cont'd)

Ventilation: General forced air
Accessibility to area: Within normal reach
Obstructions to area: Portable equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: Yes
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: 9 X 9 in. LIGHT-BROWN TILE PRIMARILY USED IN ROOM 124. SEE FIGURE 13.

BOILER INSULATION (Reference 31)

Location of asbestos-containing material: RM 130 (Interior)
Friable or non-friable: Friable
Area of insulation (SF): 1.29
Thickness of material (in.): 2.75
Estimated volume of asbestos (CF): 0.3
Condition of material: Undisturbed
Types of coatings present: Metal covering
Building use near asbestos: Industrial maintenance
Work population: None
Ventilation: Natural
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: At time of renovation, repair, or damage
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: BOILER ROOM ACCESSED FROM OUTSIDE AND IS IN A TIGHT SPACE. SEE FIGURE 14.

ROOF MATERIAL (References 15,16,18)

Asbestos-containing material found in: ROOFING
Friable or non-friable: Non-friable
Surface area (SF): 11,508
Thickness of material (in.): 2.00
Estimated volume (CF): 1918
Condition of material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: None
Building use near asbestos: Support
Work population: None

Building G-26 (Echo Site) (Cont'd)

Ventilation: Natural

Accessibility to area: > 8-ft ladder

Obstructions to area: Permanent equipment/furnishings/structures

Physical disturbances: Normal vibrations from fans, closing doors, noise, etc.

Presence of sensitive equipment: No

Suggested abatement timing: At time of demolition

Suggested abatement method: Removal

Suggested airborne monitoring: None required under normal conditions

Comments: ROOF MATERIAL COVERED WITH TAR. SEE FIGURE 14.

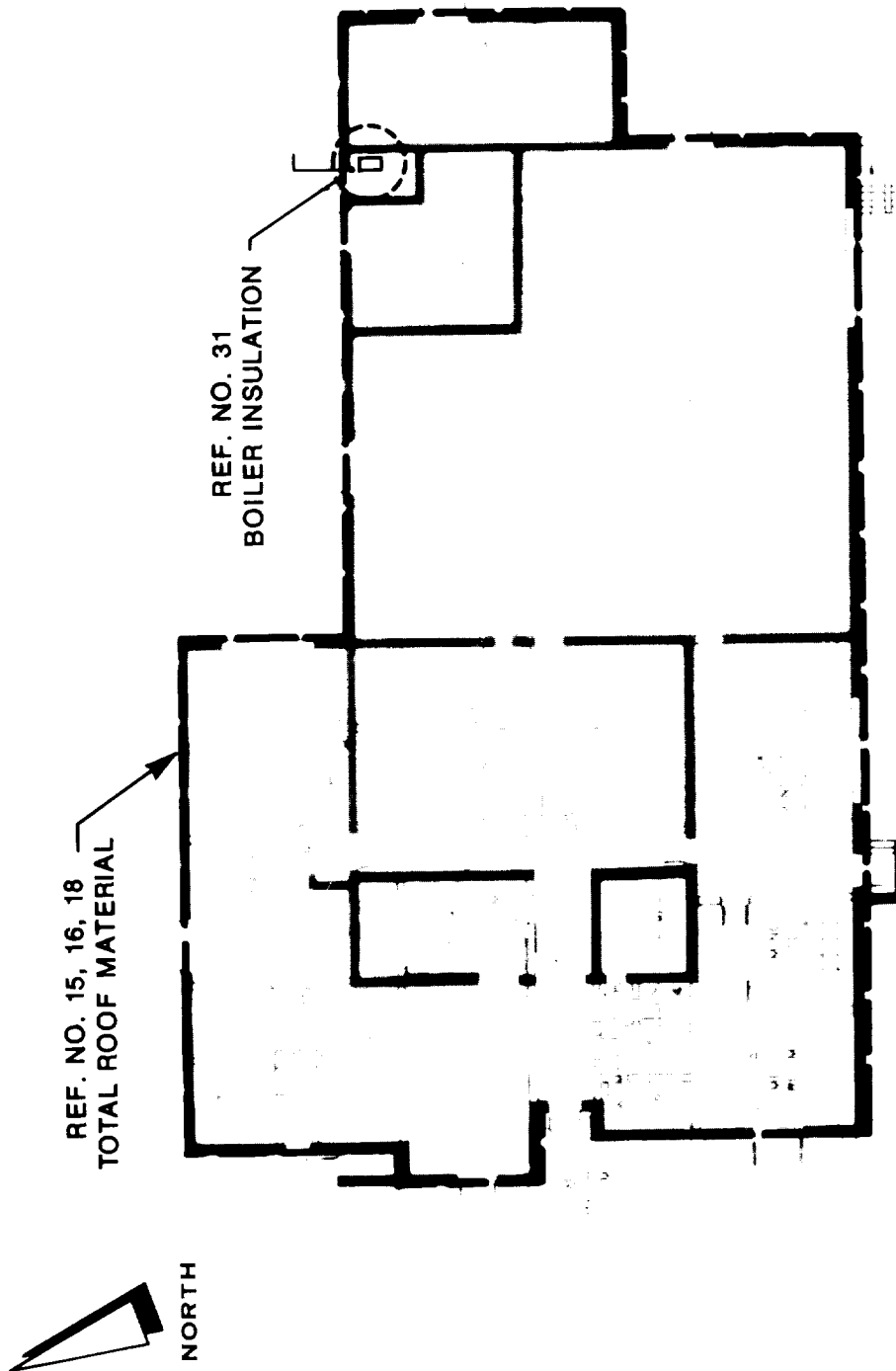


Figure 14. Echo Site: Roofing Material of Control Building G-26.

ORIGINAL PAGE IS
OF POOR QUALITY

Building G-33 (Echo Site)

GENERAL BUILDING INFORMATION

Map grid location: N 657,400/E 2,356,650
Construction date: 1958
Building type: Cement/cement block
Number of floors: 1
Total floor area (SF): 12,738
Building use: ENGINEERING/COMMUNICATIONS
Summary of asbestos use (Bldg G-33): Floors, pipelines (interior)

PIPELINES (Reference AC)

Location of pipes: RM 133
Pipe diameter with insulation (in.): 3.00
Insulation thickness (in.): 0.500
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW MATERIAL HARD CEMENTITIOUS. USED AT ENDS OF STRAIGHT RUNS AS WELL. SEE FIGURE 15.

PIPELINES (Reference AD)

Location of pipes: RM 134
Pipe diameter with insulation (in.): 6.00
Insulation thickness (in.): 0.250
Approximate pipe length (LF): 6.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder

Building G-33 (Echo Site) (Cont'd)

Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: HEATER EXHAUST VENT FLUE COVERING. SEE FIGURE 15.

PIPELINES (Reference AG)

Location of pipes: RM 134
Pipe diameter with insulation (in.): 3.00
Insulation thickness (in.): 0.500
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW MATERIAL HARD CEMENTITIOUS. SEE FIGURE 15.

PIPELINES (Reference AK)

Location of pipes: RM 140
Pipe diameter with insulation (in.): 3.00
Insulation thickness (in.): 0.500
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder

Building G-33 (Echo Site) (Cont'd)

Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW MATERIAL HARD CEMENTITIOUS. TOTAL OF 45 ELBOWS IN ROOM. SEE FIGURE 15.

PIPELINES (Reference AL)

Location of pipes: RM 140
Pipe diameter with insulation (in.): 6.00
Insulation thickness (in.): 0.250
Approximate pipe length (LF): 6.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: HEATER EXHAUST FLUE INSULATION. SEE FIGURE 15.

PIPELINES (Reference AN)

Location of pipes: RM 140
Pipe diameter with insulation (in.): 2.00
Insulation thickness (in.): 0.500
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural

Building G-33 (Echo Site) (Cont'd)

Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW MATERIAL HARD CEMENTITIOUS. TOTAL OF 17 ELBOWS IN ROOM. SEE FIGURE 15.

PIPELINES (Reference AP)

Location of pipes: RM 141
Pipe diameter with insulation (in.): 6.00
Insulation thickness (in.): 1.00
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW MATERIAL HARD CEMENTITIOUS. TOTAL OF 24 ELBOWS IN ROOM. SEE FIGURE 15.

PIPELINES (Reference AR)

Location of pipes: RM 141
Pipe diameter with insulation (in.): 3.00
Insulation thickness (in.): 0.750
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering

Building G-33 (Echo Site) (Cont'd)

Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW MATERIAL HARD CEMENTITIOUS. TOTAL OF 45 ELBOWS IN ROOM. SEE FIGURE 15.

PIPELINES (Reference AT)

Location of pipes: RM 138
Pipe diameter with insulation (in.): 2.50
Insulation thickness (in.): 0.500
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW MATERIAL HARD CEMENTITIOUS. TOTAL OF 4 ELBOWS IN ROOM. SEE FIGURE 15.

FLOORING MATERIALS (Reference GA)

Asbestos-bearing material found in: 9 X 9 in. TILE
Friable or non-friable: Non-friable
Surface area (SF): 6426
Thickness of material (in.): 0.125
Estimated volume (CF): 67
Condition of material: Undisturbed
Types of coatings present: None

Building G-33 (Echo Site) (Cont'd)

Building use near asbestos: Office/administration
Work population: 11-50
Ventilation: General forced air
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: Yes
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: 9 x 9 in. DARK GREEN TILE WITH BLEACH STREAKS. SEE FIGURE 15.

FLOORING MATERIALS (Reference GB)

Asbestos-bearing material found in: 9 X 9 in. TILE
Friable or non-friable: Non-friable
Surface area (SF): 20
Thickness of material (in.): 0.125
Estimated volume (CF): 1
Condition of material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: None
Building use near asbestos: Office/administration
Work population: 11-50
Ventilation: General forced air
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: Yes
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: 9 x 9 in. LIGHT-GREEN TILE WITH BLEACH STREAKS USED AS REPLACEMENT TILE. SEE FIGURE 15.

FLOORING MATERIALS (Reference GC)

Asbestos-bearing material found in: 9 X 9 in. TILE
Friable or non-friable: Non-friable
Surface area (SF): 1280
Thickness of material (in.): 0.125
Estimated volume (CF): 13
Condition of material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: None

Building G-33 (Echo Site) (Cont'd)

Building use near asbestos: Office/administration
Work population: 11-50
Ventilation: General forced air
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: Yes
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: 9 x 9 in. WHITE TILE WITH GRAY STREAKS. SEE FIGURE 15.

FLOORING MATERIALS (Reference GD)

Asbestos-bearing material found in: 9 X 9 in. TILE
Friable or non-friable: Non-friable
Surface area (SF): 2010
Thickness of material (in.): 0.125
Estimated volume (CF): 21
Condition of material: Undisturbed
Types of coatings present: None
Building use near asbestos: Office/administration
Work population: 11-50
Ventilation: General forced air
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: Yes
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: 9 x 9 in. ORANGE TILE WITH BEIGE STREAKS. SEE FIGURE 15.

Figure 16 depicts the Mechanical Equipment Room 141 BEFORE friable asbestos-abatement work was performed, while Figure 17 shows Room 141 AFTER friable asbestos removal and re-insulation of pipes and fittings with non-asbestos containing with Armaflex and fiberglass.

Various boilers, located in Rooms 133, 140 and 142, had their fiberglass and friable asbestos-containing insulation covering pipe fittings, pipes and flues removed and replaced with non-asbestos containing insulation.

Because of their physical separation and isolation by walls, along with ready access from the outside, Rooms 133, 140 and 142 had their friable asbestos-containing insulation removed and replaced with non-asbestos containing insulation, without affecting the health and safety of the building occupants. Of course, heating/cooling was shut down during the asbestos-abatement work.

e. Building G-38 (Figures 18 and 19)

Building G-38, the Network Laboratory and Maintenance Facility Building, provides space for a maintenance shop, offices, and storage. Figure 20 depicts Mechanical Equipment Room 115 BEFORE friable asbestos abatement work was performed, while Figure 21 shows Room 115 AFTER friable asbestos removal and re-insulation of pipes and fittings with non-asbestos containing Armaflex and fiberglass.

A Bryan Model 3095-WT Boiler, located in Room 129, was replaced by a new and equivalent Bryan Steam Boiler Model F850S15-WTAG (15 pounds/in.²). Friable asbestos insulation covering several pipe fittings, and associated with the replaced boiler, was removed and replaced with non-asbestos containing insulation.

Because of their physical separation and isolation by walls, along with ready access from the outside, Rooms 115 and 129 had their friable asbestos-containing insulation and boiler removed and replaced, without impinging upon the health and safety of the building's occupants. Of course, heating/cooling was shut down during the asbestos-abatement work.

2. Venus Site: A plot plan of the Venus Site is depicted in Figures 22 and 23

a. Building G-51 (Figure 24)

Building G-51, the Control Building, has electrical and mechanical equipment in Room 106, and a Bryan Model C-8W Boiler in Room 107. Friable asbestos and fiberglass insulation in both rooms, in general, and insulation associated with the boiler and its equipment, in Room 107, in particular, were removed and replaced with non-asbestos containing materials. The small amount of asbestos-containing materials involved permitted removal of the friable asbestos using glove-bag removal techniques.

Because of their physical separation and isolation by walls, along with ready access from the outside, Rooms 106 and 107 had their friable asbestos and fiberglass insulations removed and replaced without affecting the health and safety of the building's occupants. Of course, heating/cooling was shut down during the asbestos-abatement work.

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

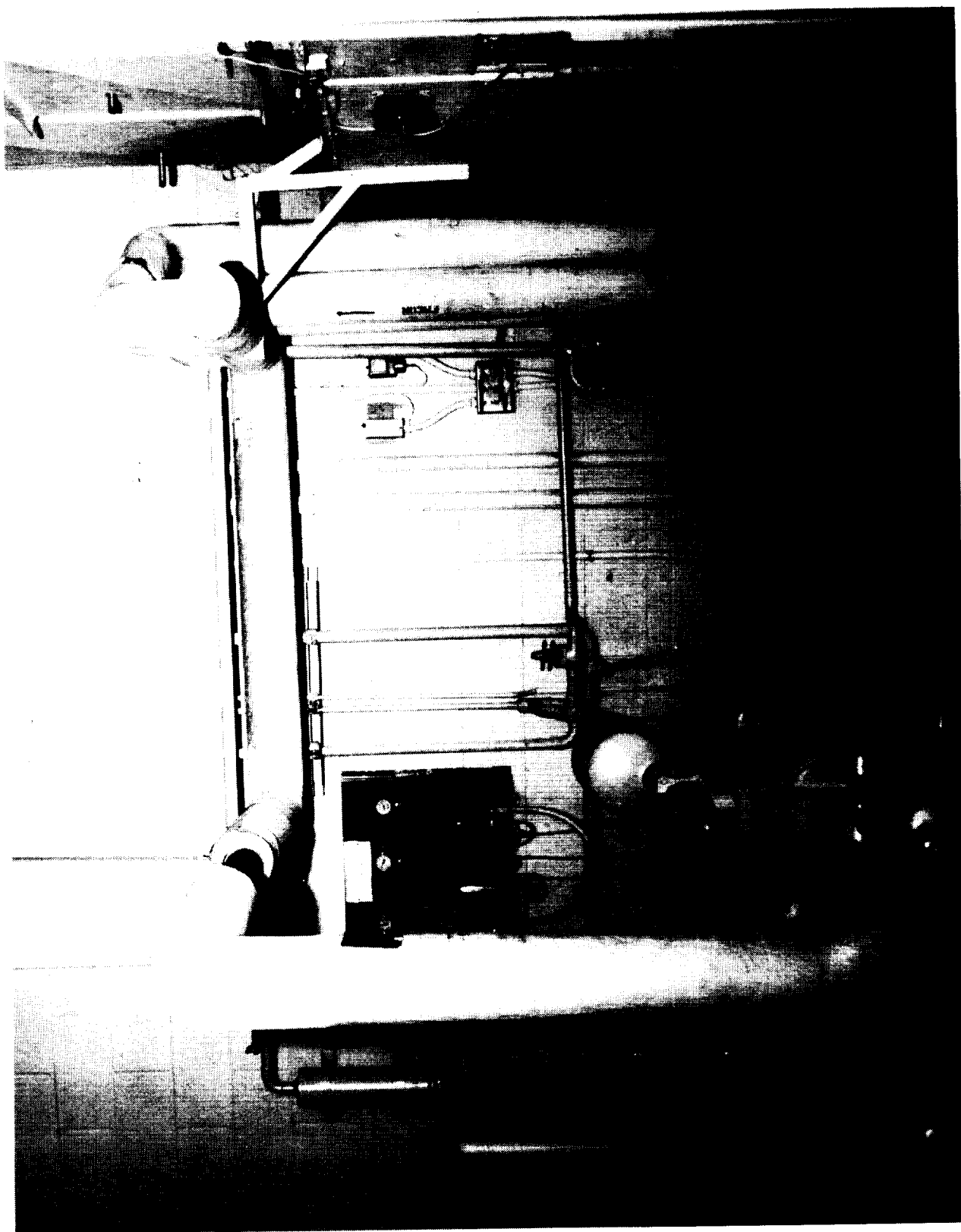


Figure 16. Echo Site: Building G-33. BEFORE Asbestos Removal. Mechanical Equipment Room 141 With Pipe Lagging Containing Friable Asbestos.

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

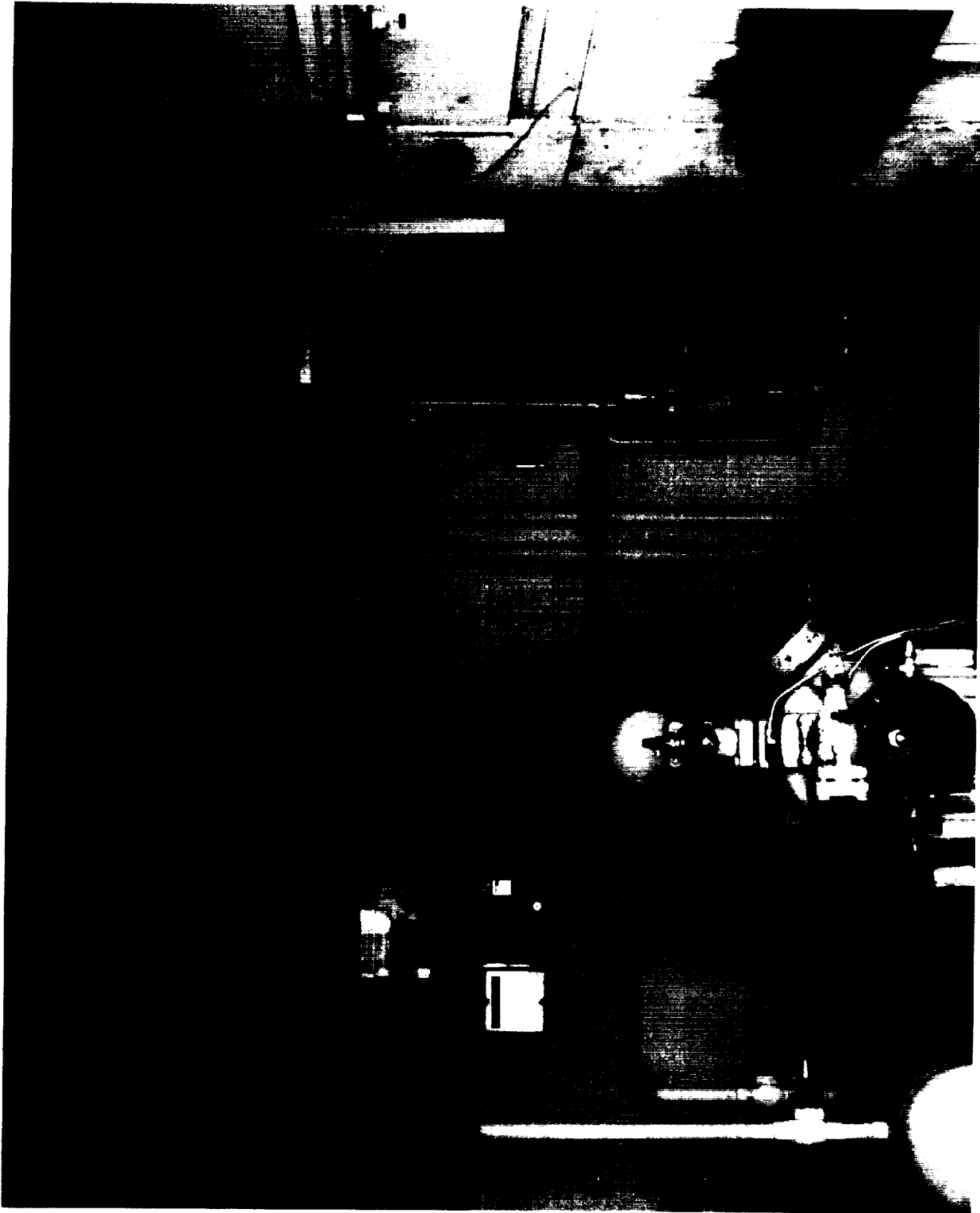


Figure 17. Echo Site: Building G-33. AFTER Asbestos Removal. Mechanical Equipment Room 141 With Asbestos Pipe Lagging Removed and Replaced With Armaflex Insulation.

Building G-38 (Echo Site)

GENERAL BUILDING INFORMATION

Map grid location: N 657,500/E 2,356,300
Construction date: 1958
Building type: Cement/cement block
Number of floors: 1
Total floor area (SF): 9396
Building use: NETWORK LABORATORY AND MAINTENANCE FACILITY
Summary of asbestos use (Bldg G-38): Floors, pipelines
(interior), pipelines (exterior), boiler insulation, roofing
materials

PIPELINES (Reference AB)

Location of pipes: RM 129
Pipe diameter with insulation (in.): 4.00
Insulation thickness (in.): 0.500
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs,
tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing,
bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal
conditions

Comments: ELBOW MATERIAL HARD CEMENTITIOUS. SEE FIGURE 18.

PIPELINES (Reference AF)

Location of pipes: RM 131
Pipe diameter with insulation (in.): 4.00
Insulation thickness (in.): 0.500
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs,
tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder

Building G-38 (Echo Site) (Cont'd)

Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: HARD CEMENTITIOUS MATERIAL USED ON ELBOWS. SEE FIGURE 18.

PIPELINES (Reference AG)

Location of pipes: RM 115
Pipe diameter with insulation (in.): 6.00
Insulation thickness (in.): 2.000
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: HARD CEMENTITIOUS ELBOW LAGGING. TOTAL OF 9 ELBOWS IN ROOM. SEE FIGURE 18.

PIPELINES (Reference AH)

Location of pipes: RM 115
Pipe diameter with insulation (in.): 4.00
Insulation thickness (in.): 0.750
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural

Building G-38 (Echo Site) (Cont'd)

Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: HARD CEMENTITIOUS MATERIAL ON PIPING ELBOW. SEE FIGURE 18.

PIPELINES (Reference AI)

Location of pipes: RM 115
Pipe diameter with insulation (in.): 3.00
Insulation thickness (in.): 1.000
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: HARD CEMENTITIOUS MATERIAL ON PIPING ELBOW. TOTAL OF 7 ELBOWS IN ROOM. SEE FIGURE 18.

PIPELINES (Reference AJ)

Location of pipes: RM 115
Pipe diameter with insulation (in.): 2.50
Insulation thickness (in.): 0.750
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural

Building G-38 (Echo Site) (Cont'd)

Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: HARD CEMENTITIOUS MATERIAL ON PIPING ELBOW. TOTAL OF 4 ELBOWS IN ROOM. SEE FIGURE 18.

FLOORING MATERIALS (Reference GB)

Asbestos-bearing material found in: 9 X 9 in. TILE
Friable or non-friable: Non-friable
Surface area (SF): 678
Thickness of material (in.): 0.125
Estimated volume (CF): 7
Condition of material: Undisturbed
Types of coatings present: None
Building use near asbestos: Office/administration
Work population: 1-10
Ventilation: General forced air
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: Yes
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: LINOLEUM SHEETING. SEE FIGURE 18.

BOILER INSULATION (Reference 25)

Location of asbestos-containing material: RM 129 (Interior)
Friable or non-friable: Friable
Area of insulation (SF): 1.29
Thickness of material (in.): 2.75
Estimated volume of asbestos (CF): 0.3
Condition of material: Undisturbed
Types of coatings present: Metal covering
Building use near asbestos: Industrial maintenance
Work population: None
Ventilation: Natural

Building G-38 (Echo Site) (Cont'd)

Accessibility to area: Within normal reach
Obstruction to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: At time of renovation, repair, or damage
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: BOILER ROOM ACCESSED FROM OUTSIDE AND IS IN A TIGHT SPACE.
SEE FIGURE 19.

ROOF MATERIAL (Reference 11)

Asbestos-containing material found in: ROOFING
Friable or non-friable: Non-friable
Surface area (SF): 9,396
Thickness of material (in.): 0.5
Estimated volume (CF): 391.5
Condition of material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: None
Building use near asbestos: Support
Work population: None
Ventilation: Natural
Accessibility to area: > 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Normal vibrations from fans, closing doors, noise, etc.
Presence of sensitive equipment: No
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ROOF MATERIAL COVERING OF TAR ON CONCRETE. SEE FIGURE 19.

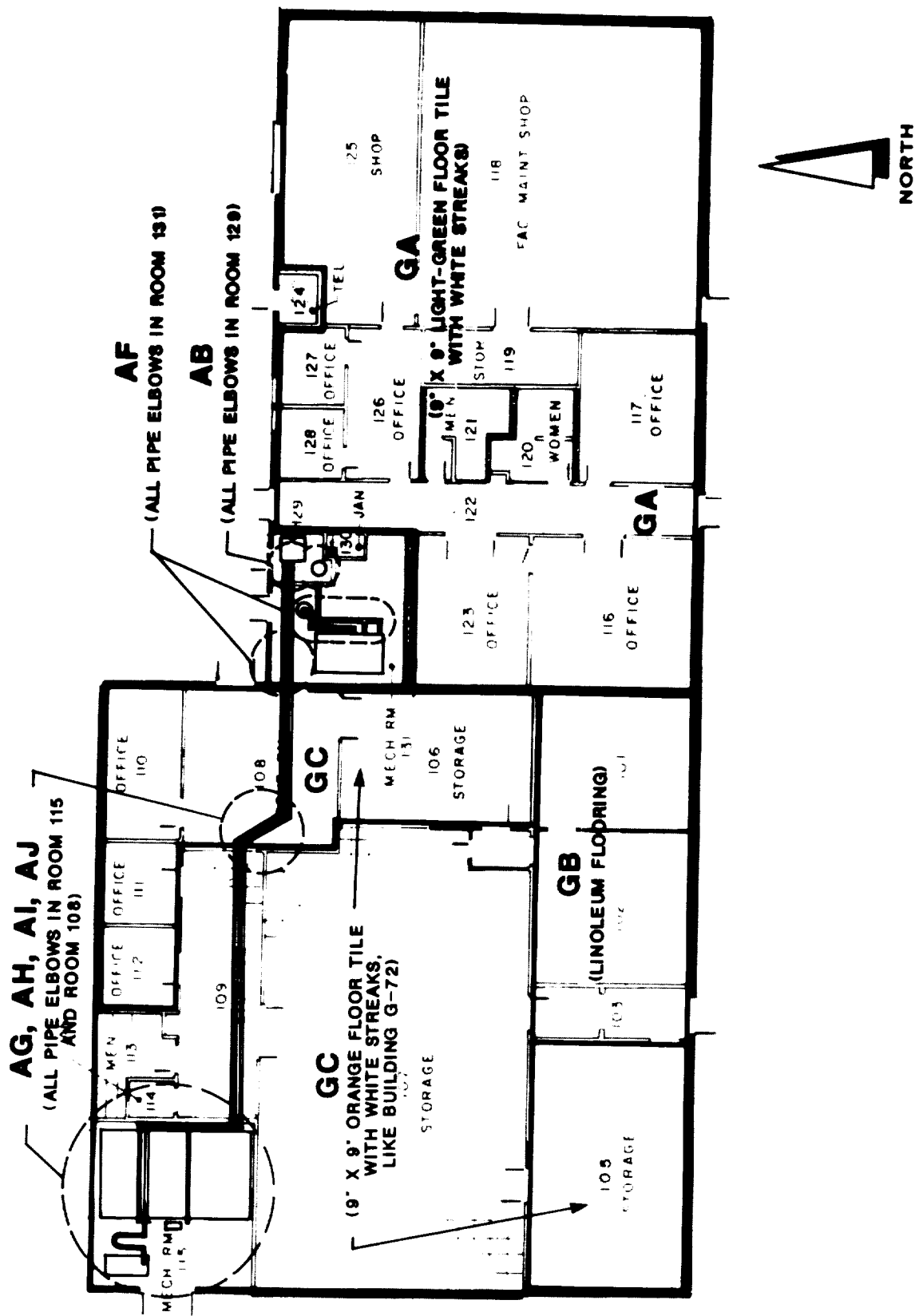


Figure 18. Echo Site: Network Laboratory and Maintenance Facility Building G-38.

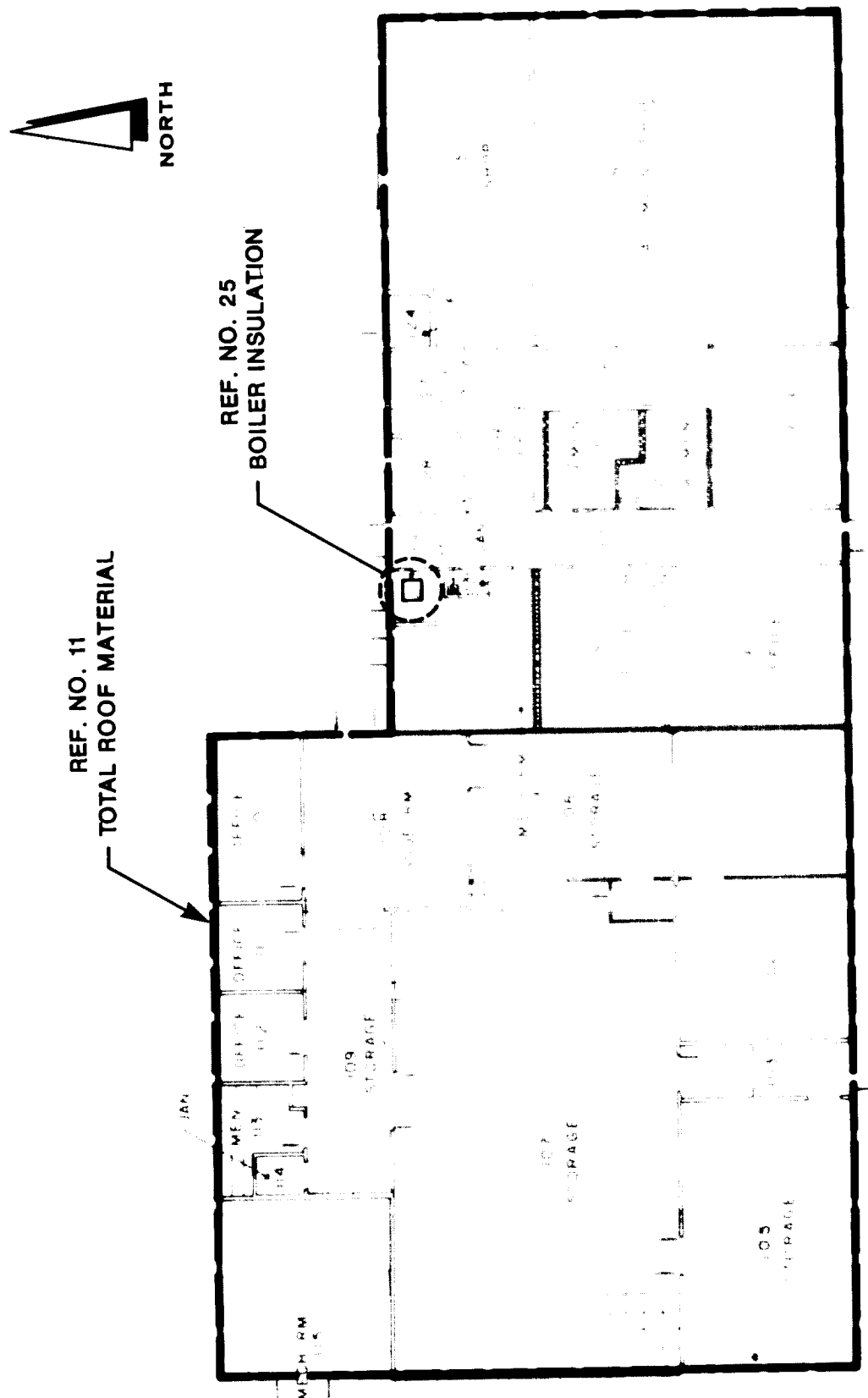


Figure 19. Echo Site: Network Laboratory and Maintenance Facility Building G-38.

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

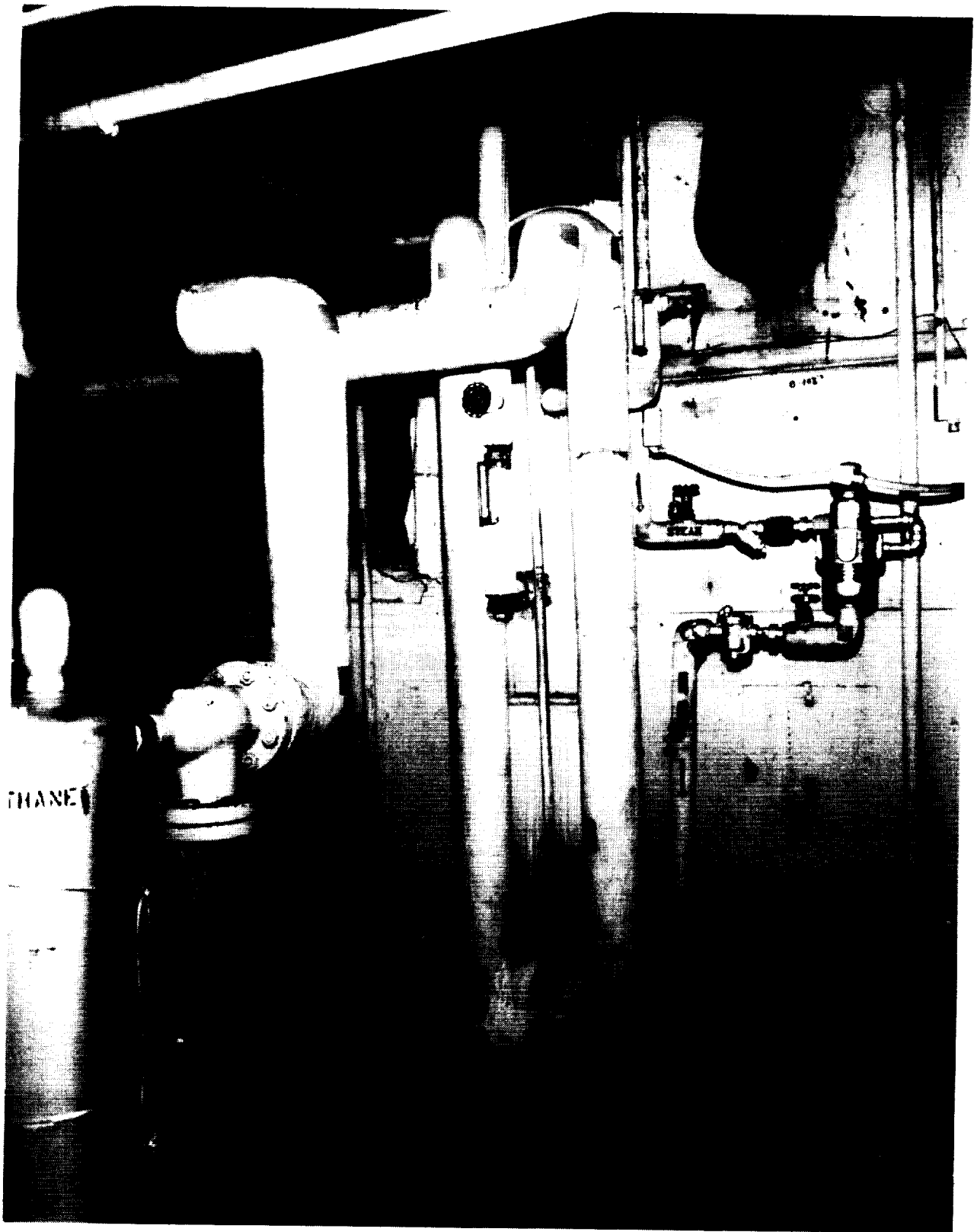


Figure 20. Echo Site: Building G-38. BEFORE Asbestos Removal.
Mechanical Equipment Room 115 With Pipe Lagging
Containing Friable Asbestos.

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

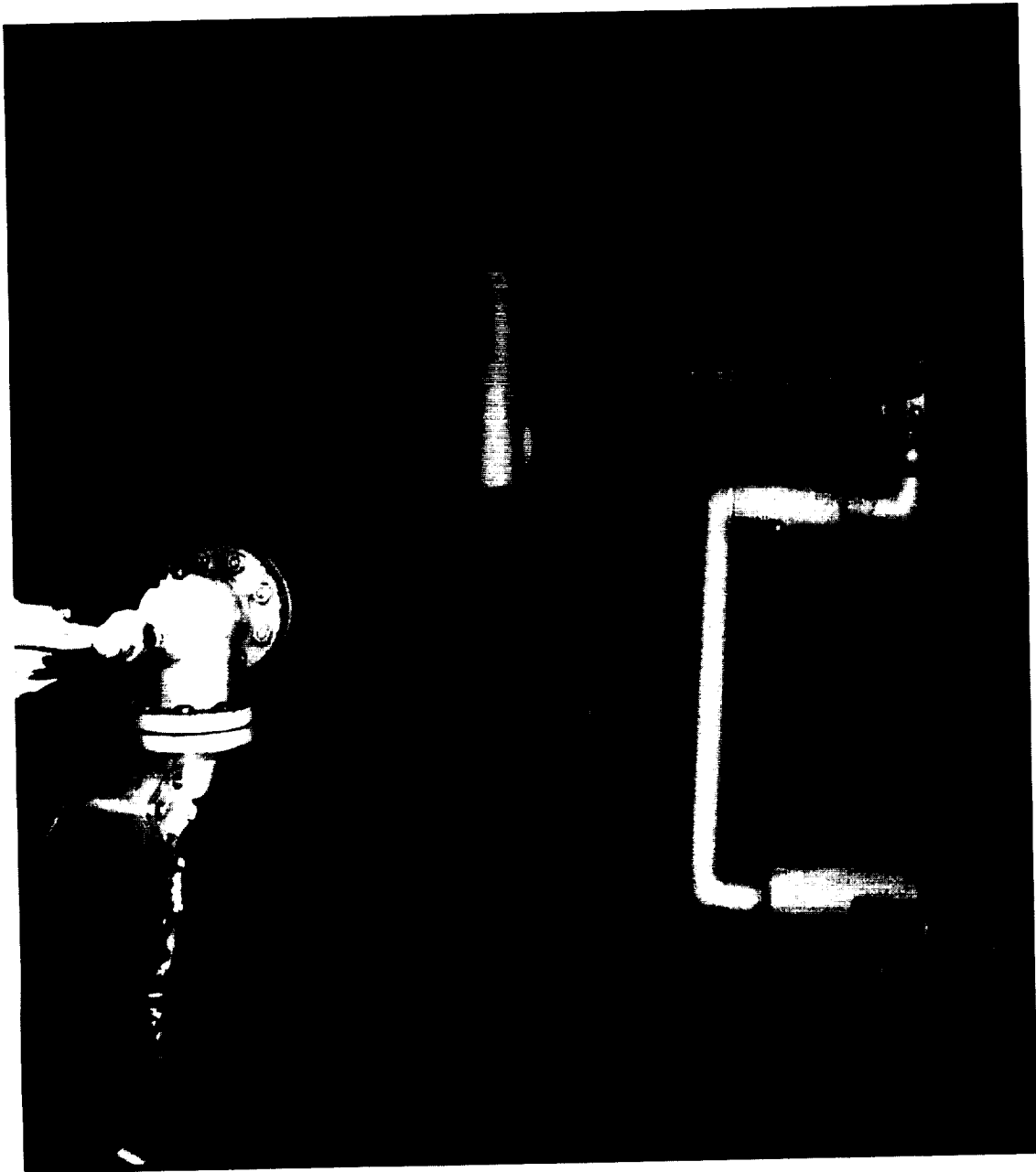
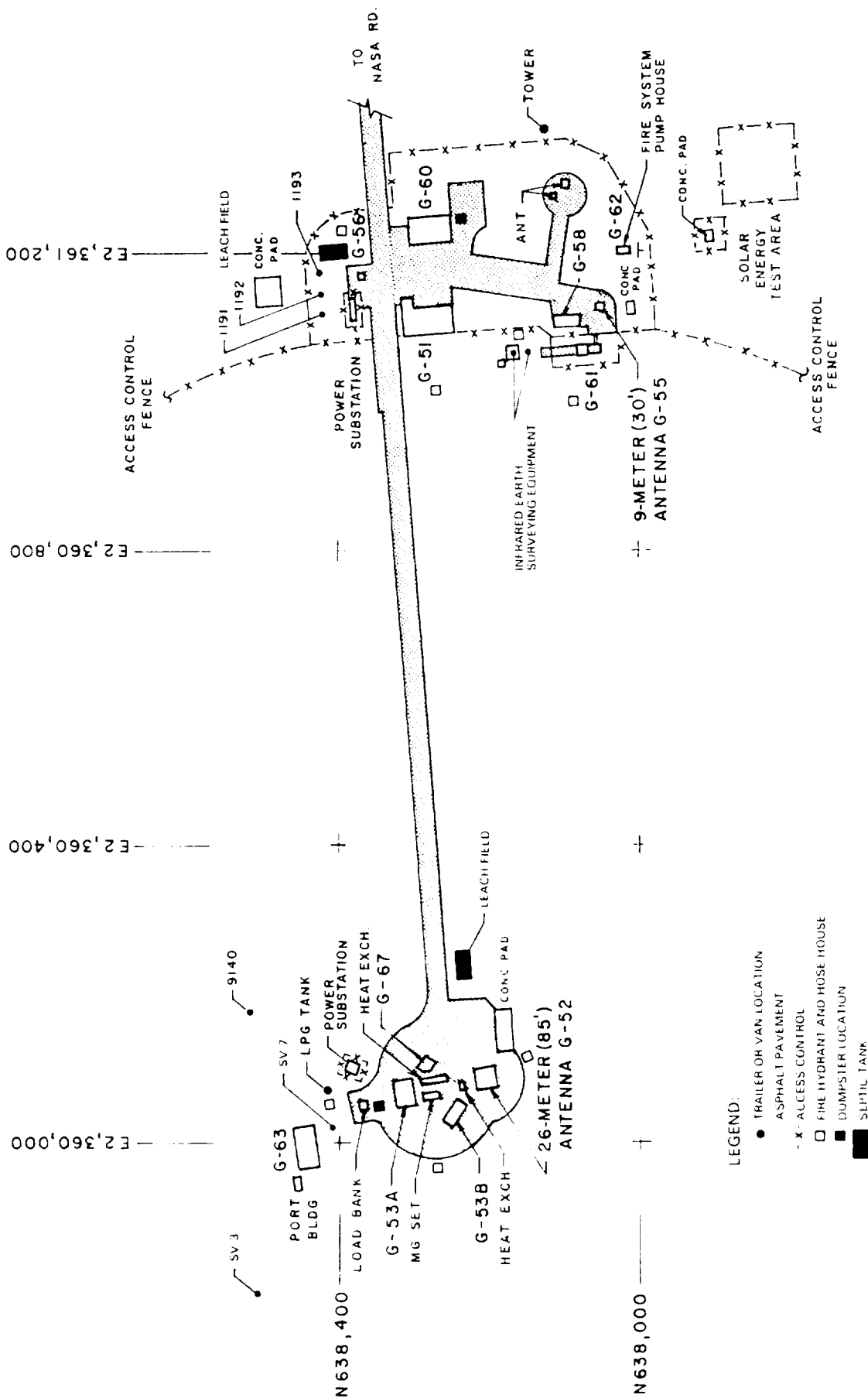


Figure 21. Echo Site: Building G-38. AFTER Asbestos Removal. Mechanical Equipment Room 115 With Friable Asbestos Pipe Lagging Removed and Replaced With Armaflex and Fiberglass Insulation.



SCALE: 1" = 200'

Figure 22. Venus Site: Existing Site Plan Before Construction Began for New 34-Meter Antenna.

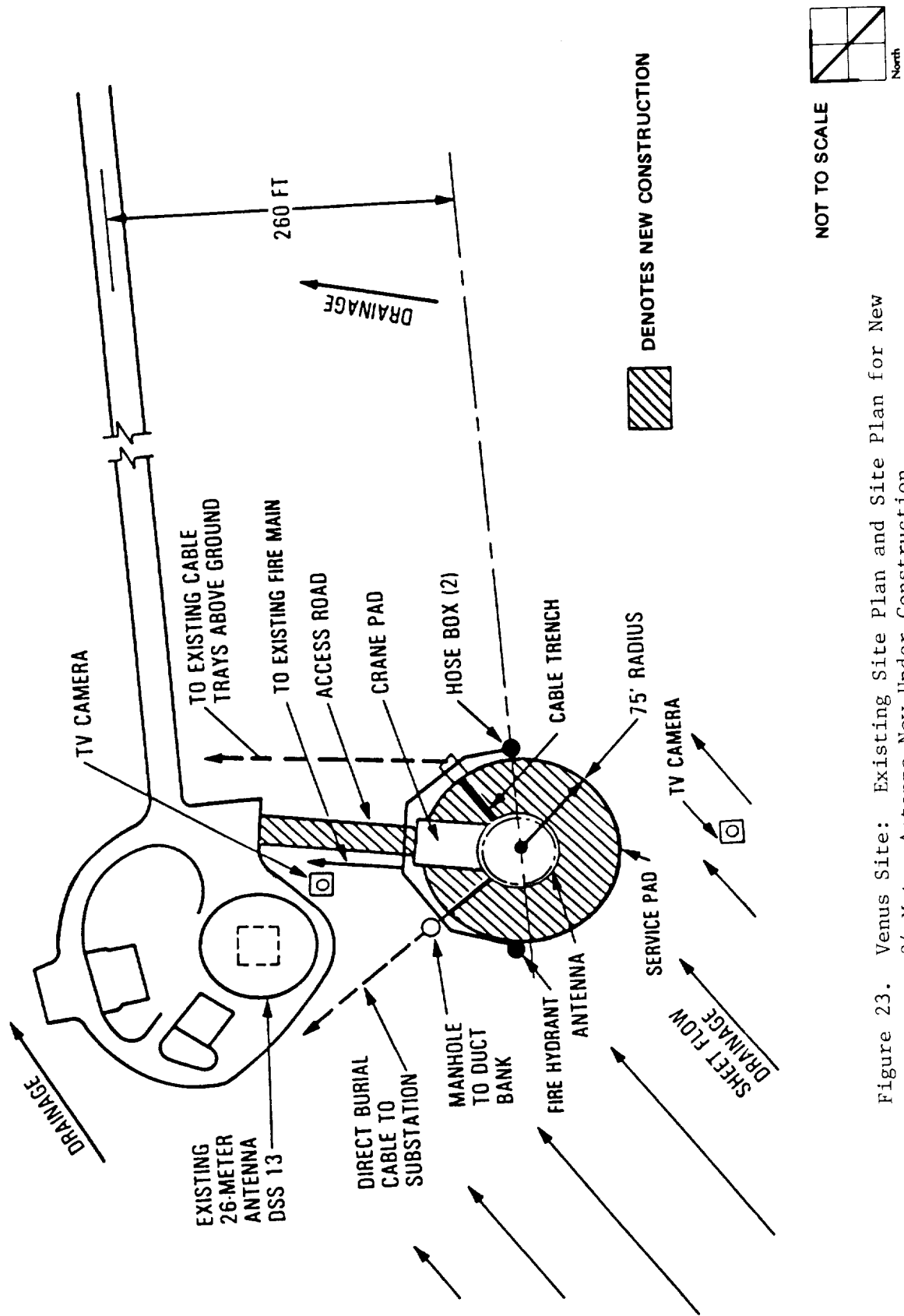


Figure 23. Venus Site: Existing Site Plan and Site Plan for New 34-Meter Antenna Now Under Construction.

Building G-51 (Venus Site)

GENERAL BUILDING INFORMATION

Map grid location: N 633,300/E2,361,100
Construction date: 1958
Building type: Cement/cement block
Number of floors: 1
Total floor area (SF): 2960
Building use: VENUS CONTROL BUILDING
Summary of asbestos use (Bldg G-51): Floors, walls, pipelines
(interior)

PIPELINES (Reference AB)

Location of pipes: RM 106
Pipe diameter with insulation (in.): 5.00
Insulation thickness (in.): 1.000
Approximate pipe length (LF): 4.00
Estimated insulation volume (CF): 2.00
Condition of lagging material: Undisturbed
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: None
Ventilation: Natural
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW OF HARD CEMENTITIOUS MATERIAL WITH SOME ADDITIONAL USE
EXTENDING AWAY FROM THE ELBOW. SEE FIGURE 24.

PIPELINES (Reference AD)

Location of pipes: RM 106
Pipe diameter with insulation (in.): 3.00
Insulation thickness (in.): 0.500
Approximate pipe length (LF): 4.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some delamination evident
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: None
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures

Building G-51 (Venus Site) (Cont'd)

Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW OF HARD CEMENTITIOUS MATERIAL EXTENDED ON STRAIGHT PIPING TO EITHER SIDE OF ELBOW. SEE FIGURE 24.

PIPELINES (Reference AE)

Location of pipes: RM 107
Pipe diameter with insulation (in.): 3.00
Insulation thickness (in.): 1.000
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Undisturbed
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: None
Ventilation: Natural
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW OF HARD CEMENTITIOUS MATERIAL. SEE FIGURE 24.

PIPELINES (Reference AF)

Location of pipes: RM 107
Pipe diameter with insulation (in.): 6.00
Insulation thickness (in.): 0.250
Approximate pipe length (LF): 2.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Undisturbed
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: None
Ventilation: Natural
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)

Building G-51 (Venus Site) (Cont'd)

Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: EXHAUST FLUE INSULATION. SEE FIGURE 24.

WALL STRUCTURES/PARTITIONS (Reference CA)

Asbestos-bearing material found in: Wall structure
Friable or non-friable: Friable
Surface area (SF): 1120
Thickness of material (in.): 0.625
Estimated volume of asbestos (CF): 58
Condition of material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: None
Building use near asbestos: Office/administration
Work population: 1-10
Ventilation: General forced air
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: Yes
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: 1 X 1' PINHOLE ACOUSTICAL TILE IN ROOM 101 ON THE WALLS. TILE HAS STANDARD COATING OF WHITE PAINT. SEE FIGURE 24.

FLOORING MATERIALS (Reference GA)

Asbestos-bearing material found in: 9 X 9 in. TILE
Friable or non-friable: Non-friable
Surface area (SF): 1500
Thickness of material (in.): 0.062
Estimated volume (CF): 8
Condition of material: Undisturbed
Types of coatings present: None
Building use near asbestos: Office/administration
Work population: 1-10
Ventilation: General forced air
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: Yes

Building G-51 (Venus Site) (Cont'd)

Suggested abatement timing: At time of demolition

Suggested abatement method: Removal

Suggested airborne monitoring: None required under normal conditions

Comments: 9 in. X 2 ft. BEIGE TILE WITH SPECKS. ROOMS 102, 103, AND 105 CONTAIN 9 X 9 in. GREEN TILE WITH WHITE STREAKS LIKE FLOORING IN BUILDING G-56. SEE FIGURE 24.

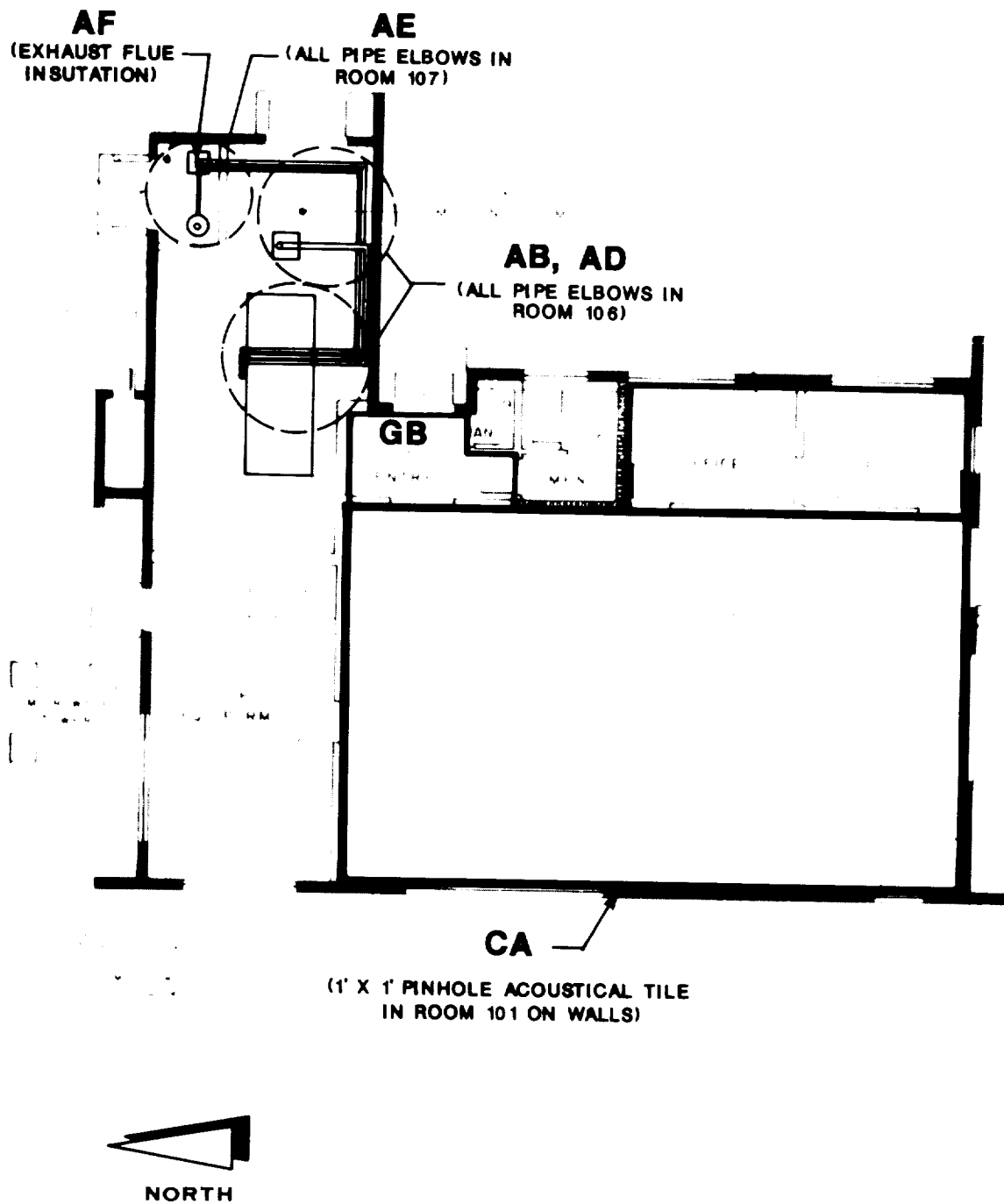


Figure 24. Venus Site: Control Building G-51.

ORIGINAL PAGE IS
OF POOR QUALITY

3. Microwave Test Facility: A plot plan of the Microwave Test Facility and Fire Training Area is depicted in Figure 25.

a. Building G-72 (Figures 26 and 27)

Building G-72, the Microwave Test Facility Laboratory and Office Building, houses offices, shops, and laboratories.

A Bryan Model C-8W Boiler, located in Room 110, was replaced by a new and equivalent Bryan Hot Water Gas Fired Boiler Model F150WAG. Fiberglass and friable asbestos insulation (associated with pipes, pipe fittings, and boiler exhaust flue) were removed and replaced with non-asbestos containing insulation.

Figure 28 depicts Mechanical Equipment Room 111 BEFORE friable asbestos abatement work was performed, while Figure 29 shows Room 111 AFTER friable asbestos removal and re-insulation of pipes and fittings with non-asbestos containing Armaflex and fiberglass.

Because of their physical separation and isolation by walls, along with ready access from the outside, Rooms 110 and 111 had their friable asbestos-containing insulation and boiler removed and replaced without impinging upon the health and safety of the occupants of the buildings. Of course, heating/cooling was shut down during the asbestos-abatement work.

4. Mars Site: A plot plan of the Mars Site is shown in Figure 30.

Building G-86 (Figures 31 and 32)

Building G-86, Operations Control Building, is a two-story structure used as an operations control center for remote control of missions involving the use of the Mars 70-meter (230-ft) antenna (DSS-14), the Uranus 34-meter (111.5-ft) high-efficiency antenna (DSS-15), and the Echo 34-meter (111.5-ft) antenna (DSS-12). A proposed addition to the Operations Control Building is described in JPL Publication, Volume 11, Environmental Assessment: Addition to Operations Building, Mars Site (February 15, 1990).

The first floor of Building G-86 houses mechanical and air-handling equipment, and plenum rooms, while the second story consists of the operations control center, the control rooms and common rooms.

Pipes and pipe fittings insulated with friable asbestos in Room 104, the Mechanical Equipment Room, had their insulation removed and replaced with non-asbestos containing insulation. Because of its physical separation and isolation by walls, and its easy access from the outside, Room 104 had its friable asbestos-containing insulation removed and replaced without affecting the health and safety of the building's personnel.

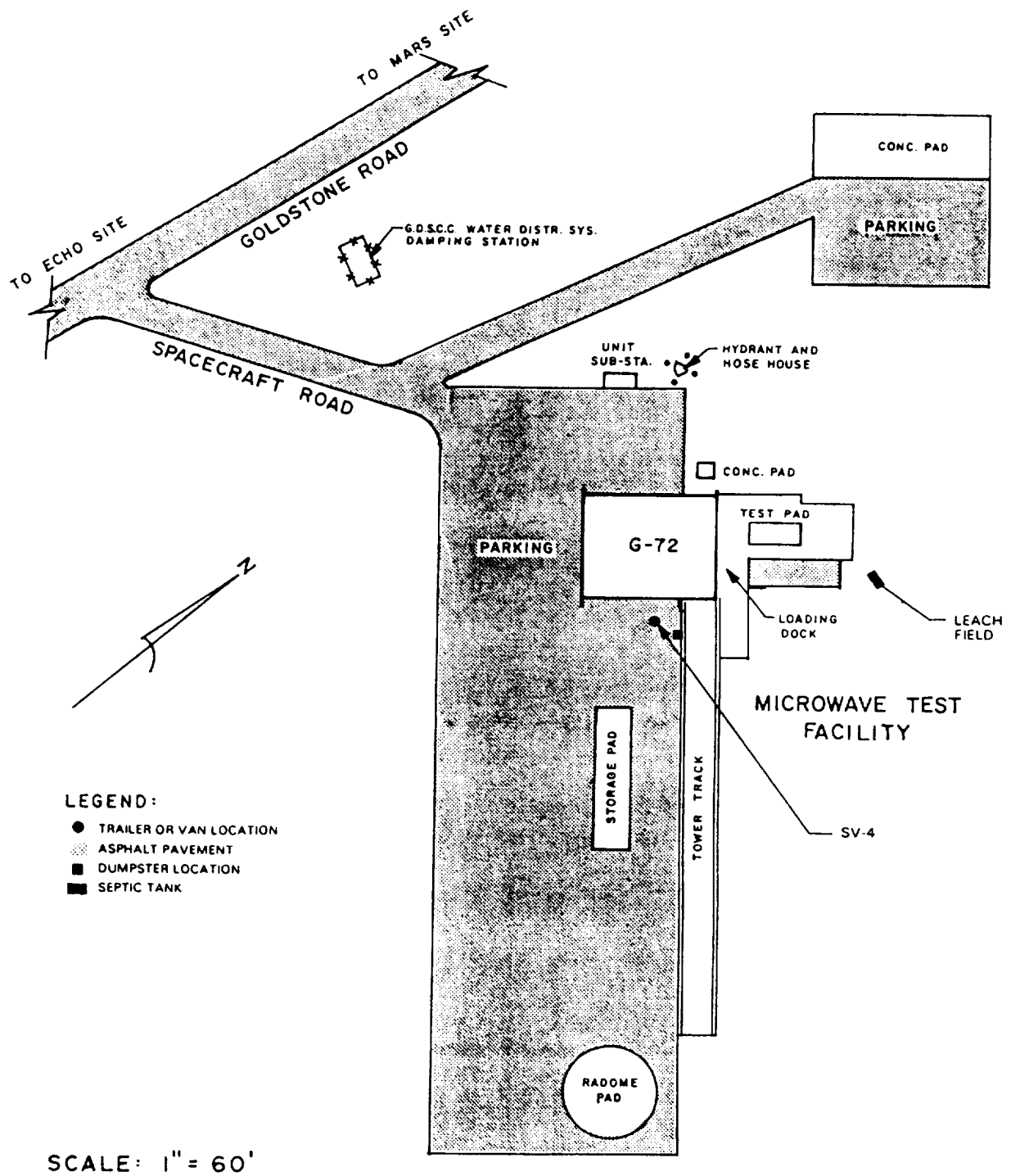


Figure 25. Microwave Test Facility Plot Plan.

Building G-72 (Microwave Test Facility)

GENERAL BUILDING INFORMATION

Map grid location: NOT AVAILABLE
Construction date: 1958
Building type: Cement/cement block
Number of floors: 1
Total floor area (SF): 2880
Building use: MICROWAVE TEST FACILITY
Summary of asbestos use (Bldg G-72): Floors, pipelines (interior),
boiler insulation, roofing materials

PIPELINES (Reference AB)

Location of pipes: RM 110
Pipe diameter with insulation (in.): 3.00
Insulation thickness (in.): 0.500
Approximate pipe length (LF): 5.00
Estimated insulation volume: (CF) 1.00
Condition of lagging material: Undisturbed
Types of coatings present: Coatings/encapsulants
Building use near pipes: Industrial maintenance
Work population: None
Ventilation: None
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing,
bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal
conditions

Comments: ELBOW OF HARD CEMENTITIOUS MATERIAL; OTHER AREAS OF PIPING
ALSO MADE OF SAME MATERIAL. SEE FIGURE 26.

PIPELINES (Reference AE)

Location of pipes: RM 110
Pipe diameter with insulation (in.): 3.00
Insulation thickness (in.): 0.500
Approximate pipe length (LF): 1.00
Estimated insulation volume: (CF) 1.00
Condition of lagging material: Undisturbed
Types of coatings present: Coatings/encapsulants
Building use near pipes: Industrial maintenance
Work population: None
Ventilation: Natural
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures

Building G-72 (Microwave Test Facility) (Cont'd)

Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)

Presence of sensitive equipment: No

Suggested abatement timing: In the near future

Suggested abatement method: Removal

Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW OF HARD CEMENTITIOUS MATERIAL. SEE FIGURE 26.

PIPELINES (Reference AF)

Location of pipes: RM 110

Pipe diameter with insulation (in.): 6.00

Insulation thickness (in.): 0.250

Approximate pipe length (LF): 5.00

Estimated insulation volume: (CF) 1.00

Condition of lagging material: Undisturbed

Types of coatings present: Coatings/encapsulants

Building use near pipes: Industrial maintenance

Work population: None

Ventilation: Natural

Accessibility to area: 8-ft ladder

Obstructions to area: Permanent equipment/furnishings/structures

Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)

Presence of sensitive equipment: No

Suggested abatement timing: In the near future

Suggested abatement method: Removal

Suggested airborne monitoring: None required under normal conditions

Comments: HEATER EXHAUST VENT FLUE COVERING. SEE FIGURE 26.

PIPELINES (Reference AH)

Location of pipes: RM 111

Pipe diameter with insulation (in.): 3.00

Insulation thickness (in.): 0.500

Approximate pipe length (LF): 5.00

Estimated insulation volume: (CF) 1.00

Condition of lagging material: Undisturbed

Types of coatings present: Coatings/encapsulants

Building use near pipes: Industrial maintenance

Work population: None

Ventilation: Natural

Accessibility to area: Within normal reach

Obstructions to area: Permanent equipment/furnishings/structures

Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)

Building G-72 (Microwave Test Facility) (Cont'd)

Presence of sensitive equipment: Yes
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW OF HARD CEMENTITIOUS MATERIAL. SEE FIGURE 26.

PIPELINES (Reference AJ)

Location of pipes: RM 111
Pipe diameter with insulation (in.): 5.00
Insulation thickness (in.): 1.500
Approximate pipe length (LF): 16.00
Estimated insulation volume: (CF) 4.00
Condition of lagging material: Undisturbed
Types of coatings present: Coatings/encapsulants
Building use near pipes: Industrial maintenance
Work population: None
Ventilation: Natural
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: Yes
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW OF HARD CEMENTITIOUS MATERIAL. SEE FIGURE 26.

FLOORING MATERIALS (Reference GA)

Asbestos-bearing material found in: 9 X 9 in. TILE
Friable or non-friable: Non-friable
Surface area (SF): 400
Thickness of material (in.): 0.250
Estimated volume (CF): 8
Condition of material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: None
Building use near asbestos: Industrial warehouse
Work population: 1-10
Ventilation: General forced air
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)

Building G-72 (Microwave Test Facility) (Cont'd)

Presence of sensitive equipment: Yes
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: 9 X 9 in. ORANGE TILE WITH WHITE STREAKS. SEE FIGURE 26.

FLOORING MATERIALS (Reference GB)

Asbestos-bearing material found in: 9 X 9 in. TILE
Friable or non-friable: Non-friable
Surface area (SF): 1640
Thickness of material (in.): 0.250
Estimated volume (CF): 34
Condition of material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: None
Building use near asbestos: Industrial warehouse
Work population: 1-10
Ventilation: General forced air
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: Yes
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: 9 X 9 in. LIGHT-GREEN TILE WITH WHITE STREAKS. SEE FIGURE 26.

FLOORING MATERIALS (Reference GC)

Asbestos-bearing material found in: 9 X 9 in. TILE
Friable or non-friable: Non-friable
Surface area (SF): 11
Thickness of material (in.): 0.250
Estimated volume (CF): 1
Condition of material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: None
Building use near asbestos: Industrial warehouse
Work population: 1-10
Ventilation: General forced air
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)

Building G-72 (Microwave Test Facility) (Cont'd)

Presence of sensitive equipment: Yes
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: 9 X 9 in. DARK GREEN TILE USED AS REPLACEMENT TILE.
SEE FIGURE 26.

FLOORING MATERIALS (Reference GD)

Asbestos-bearing material found in: 9 X 9 in. TILE
Friable or non-friable: Non-friable
Surface area (SF): 340
Thickness of material (in.): 0.250
Estimated volume (CF): 7
Condition of material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: None
Building use near asbestos: Industrial warehouse
Work population: 1-10
Ventilation: General forced air
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: Yes
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: 9 X 9 in. BROWN TILE WITH MULTICOLORED SPECKLES. SEE FIGURE 26.

BOILER INSULATION (Reference 43)

Location of asbestos-containing material: RM 110 (Interior)
Friable or non-friable: Friable
Area of insulation (SF): 1.45
Thickness of material (in.): 3.00
Estimated volume of asbestos (CF): 0.4
Condition of material: Undisturbed
Types of coatings present: Metal covering
Building use near asbestos: Industrial maintenance
Work population: None
Ventilation: Natural
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)

Building G-72 (Microwave Test Facility) (Cont'd)

Presence of sensitive equipment: No
Suggested abatement timing: At time of renovation, repair, or damage
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: BOILER ROOM ACCESSED FROM OUTSIDE AND IS IN A TIGHT SPACE. SEE FIGURE 27.

ROOF MATERIAL (Reference 20)

Asbestos-containing material found in: ROOFING
Friable or non-friable: Non-friable
Surface area (SF): 2,880
Thickness of material (in.): 4.50
Estimated volume (CF): 1080
Condition of material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: None
Building use near asbestos: Support
Work population: None
Ventilation: Natural
Accessibility to area: > 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Normal vibrations from fans, closing doors, noise, etc.
Presence of sensitive equipment: No
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ROOF MATERIAL COVERED WITH TAR. SEE FIGURE 27.

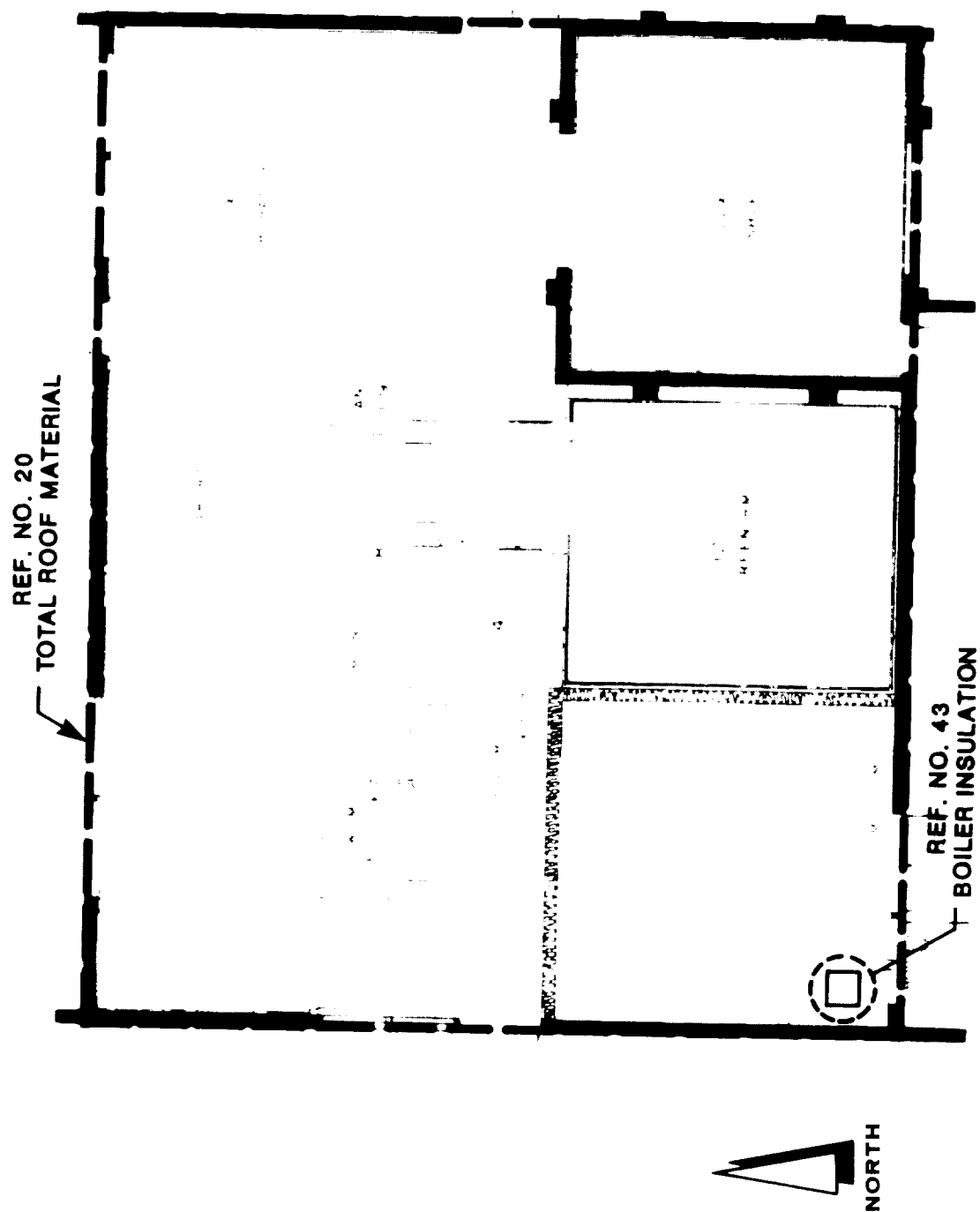


Figure 27. Microwave Test Facility: Roofing Material of Microwave Test Facility Building G-72.

ORIGINAL PAGE IS
OF POOR QUALITY

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

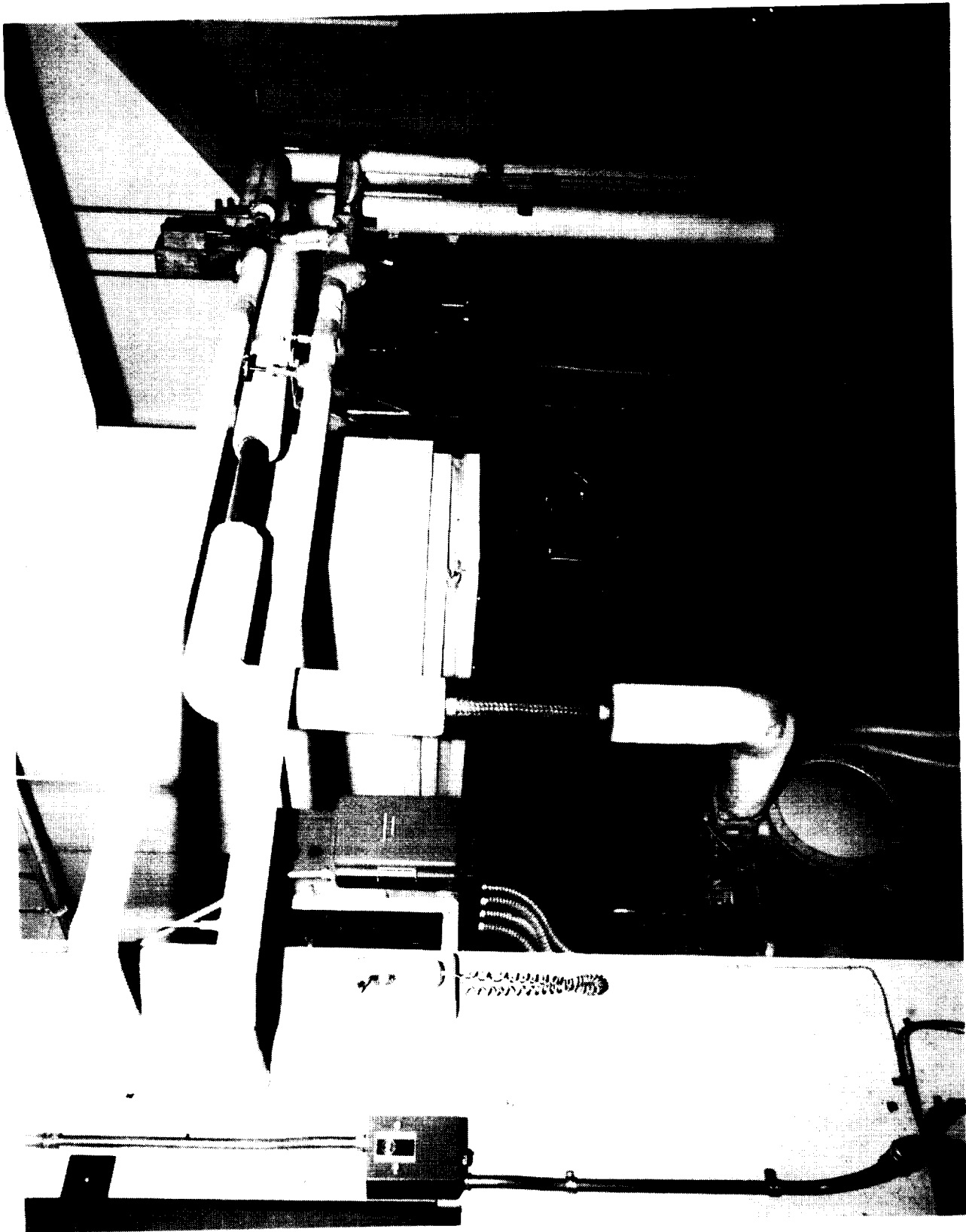


Figure 28. Microwave Test Facility: Building G-72. BEFORE Asbestos Removal. Mechanical Equipment Room 111 With Pipe Lagging Containing Friable Asbestos.

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

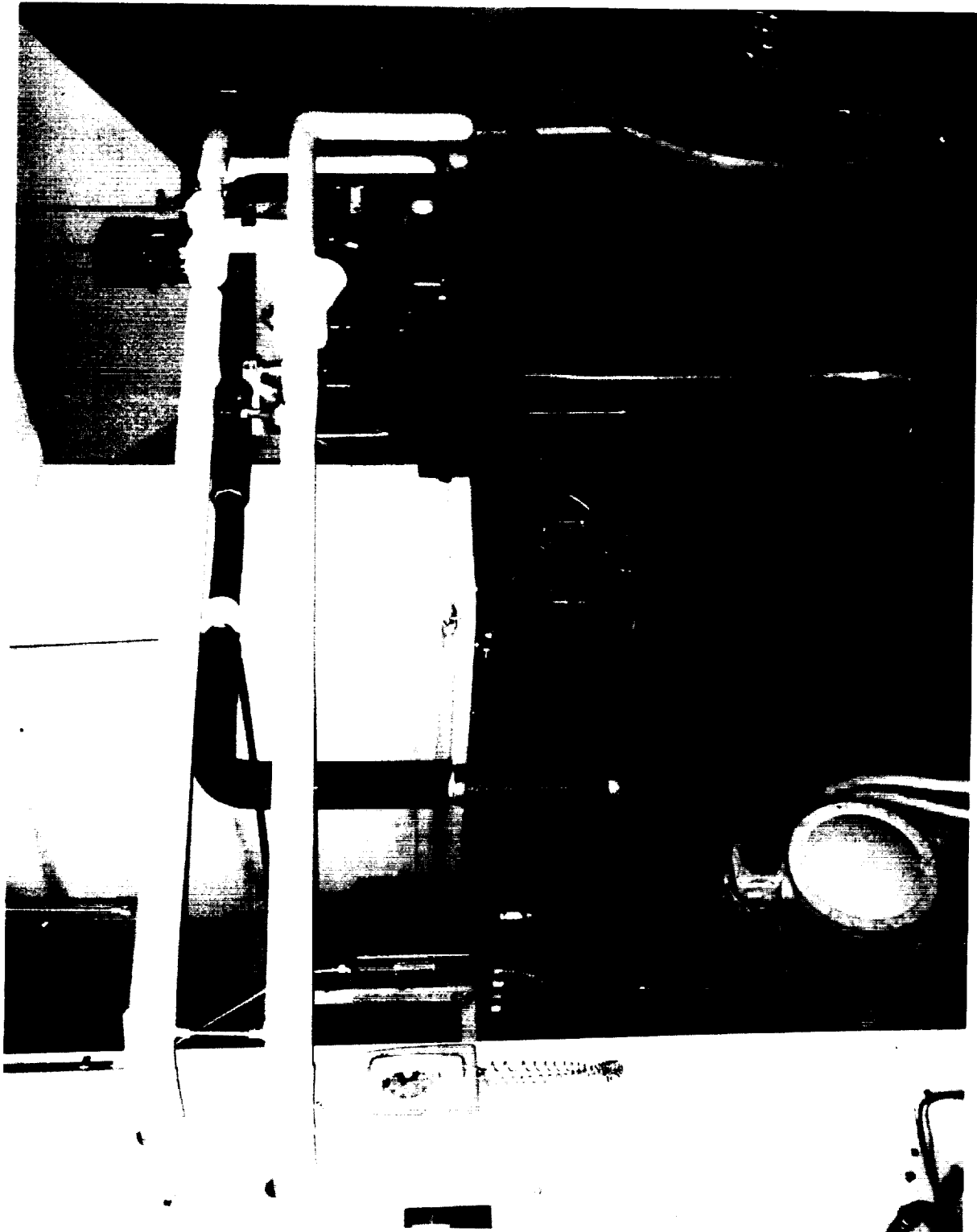


Figure 29. Microwave Test Facility: Building G-72. AFTER Asbestos Removal. Mechanical Equipment Room 111 With Friable Asbestos Pipe Lagging Removed and Replaced With Armaflex and Fiberglass Insulation.

Building G-86 (Mars Site)

GENERAL BUILDING INFORMATION

Map grid location: NOT AVAILABLE
Construction date: 1969
Building type: Cement/cement block
Number of floors: 1
Total floor area (SF): 13,680
Building use: OPERATIONS SUPPORT
Summary of asbestos use (Bldg G-86): Floors, pipelines (interior),
roofing materials

PIPELINES (Reference AA)

Location of pipes: RM 104
Pipe diameter with insulation (in.): 4.00
Insulation thickness (in.): 0.750
Approximate pipe length (LF): 5.00
Estimated insulation volume: (CF) 1.00
Condition of lagging material: Some physical damage (scuffs,
tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing,
bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal
conditions

Comments: STRAIGHT PIPE LAGGING HARD CEMENTITIOUS MATERIAL. SEE
FIGURE 31.

PIPELINES (Reference AB)

Location of pipes: RM 104
Pipe diameter with insulation (in.): 4.00
Insulation thickness (in.): 0.750
Approximate pipe length (LF): 1.00
Estimated insulation volume: (CF) 1.00
Condition of lagging material: Some physical damage (scuffs,
tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder

Building G-86 (Mars Site) (Cont'd)

Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: STRAIGHT PIPE LAGGING HAS HARD CEMENTITIOUS MATERIAL.
SEE FIGURE 31.

PIPELINES (Reference AC)

Location of pipes: RM 104
Pipe diameter with insulation (in.): 4.00
Insulation thickness (in.): 0.750
Approximate pipe length (LF): 1.00
Estimated insulation volume: (CF) 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW HARD CEMENTITIOUS MATERIAL. SEE FIGURE 31.

PIPELINES (Reference AD)

Location of pipes: RM 104
Pipe diameter with insulation (in.): 4.00
Insulation thickness (in.): 0.750
Approximate pipe length (LF): 1.00
Estimated insulation volume: (CF) 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises.)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural

Building G-86 (Mars Site) (Cont'd)

Accessibility to area: 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW HAS HARD CEMENTITIOUS MATERIAL. SEE FIGURE 31.

WALL STRUCTURES/PARTITIONS (Reference CA)

Asbestos-bearing material found in: Wall structure
Friable or non-friable: Non-friable
Surface area (SF): 768
Thickness of material (in.): 0.75
Estimated volume of asbestos (CF): 48
Condition of material: Undisturbed
Types of coatings present: Coatings/encapsulants
Building use near asbestos: Casual or incidental
Work population: 1-10
Ventilation: General forced air
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: Yes
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: TAPE VAULT WALLS ARE IN GOOD CONDITION. MAINTAIN A GOOD PROTECTIVE COATING ON WALLS. SEE FIGURE 31.

FLOORING MATERIALS (Reference GA)

Asbestos-bearing material found in: 9 X 9 in. TILE
Friable or non-friable: Non-friable
Surface area (SF): 7150
Thickness of material (in.): 0.125
Estimated volume (CF): 75
Condition of material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: None
Building use near asbestos: Office/administration
Work population: 11-50
Ventilation: General forced air
Accessibility to area: Within normal reach

Building G-86 (Mars Site) (Cont'd)

Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: Yes
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: 9 X 9 in. WHITE TILE WITH GRAY STREAKS. SEE FIGURE 31.

ROOF MATERIAL (Reference 23)

Asbestos-containing material found in: ROOFING
Friable or non-friable: Non-friable
Surface area (SF): 1,440
Thickness of material (in.): 4.25
Estimated volume (CF): 510
Condition of material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: None
Building use near asbestos: Support
Work population: None
Ventilation: Natural
Accessibility to area: > 8-ft ladder
Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Normal vibrations from fans, closing doors, noise, etc.
Presence of sensitive equipment: No
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ROOF MATERIAL COVERED WITH TAR. SEE FIGURE 32.

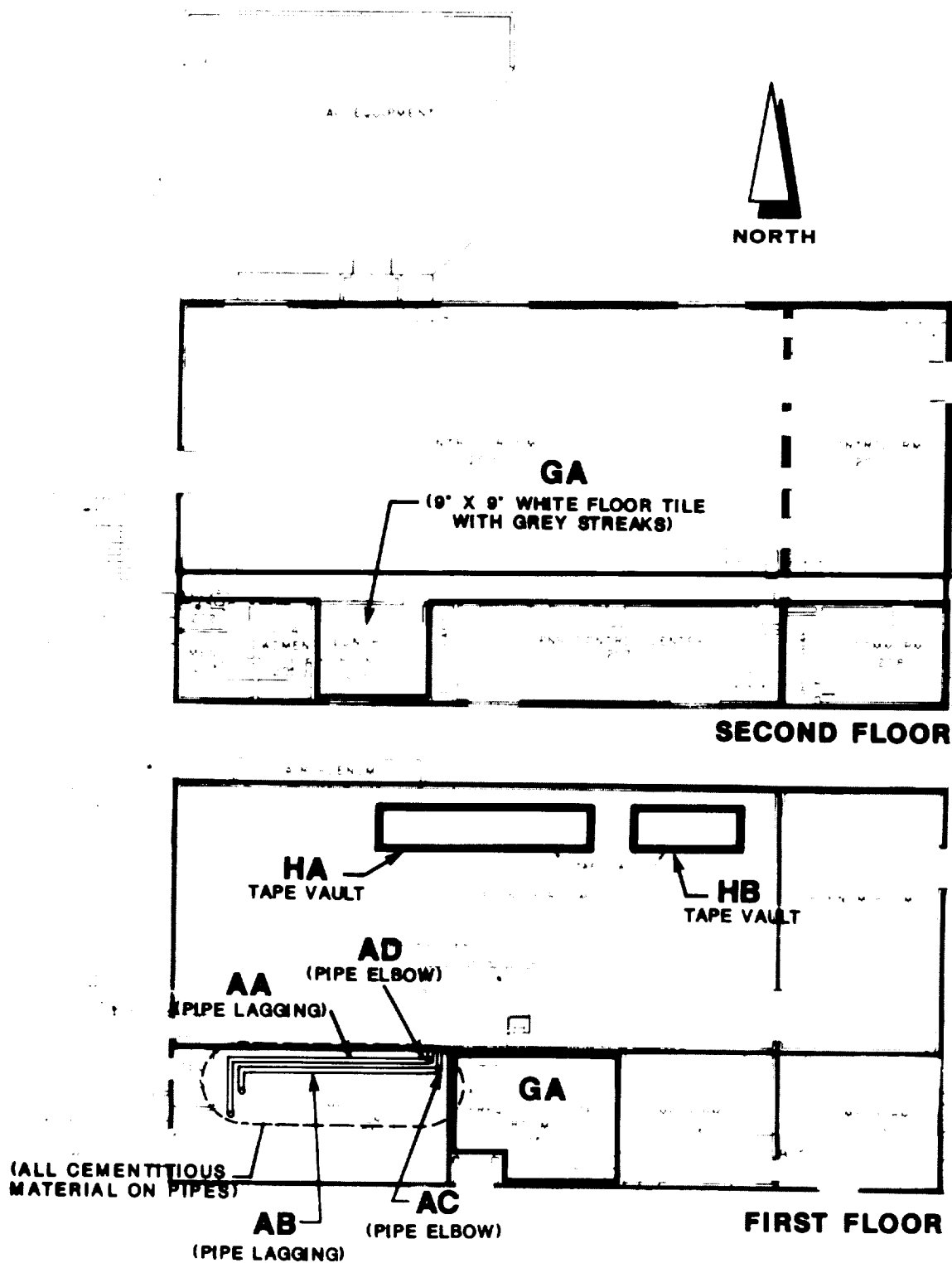


Figure 31. Mars Site: Operations Support Building G-86.

ORIGINAL PAGE IS
OF POOR QUALITY

TOTAL ROOF MATERIAL

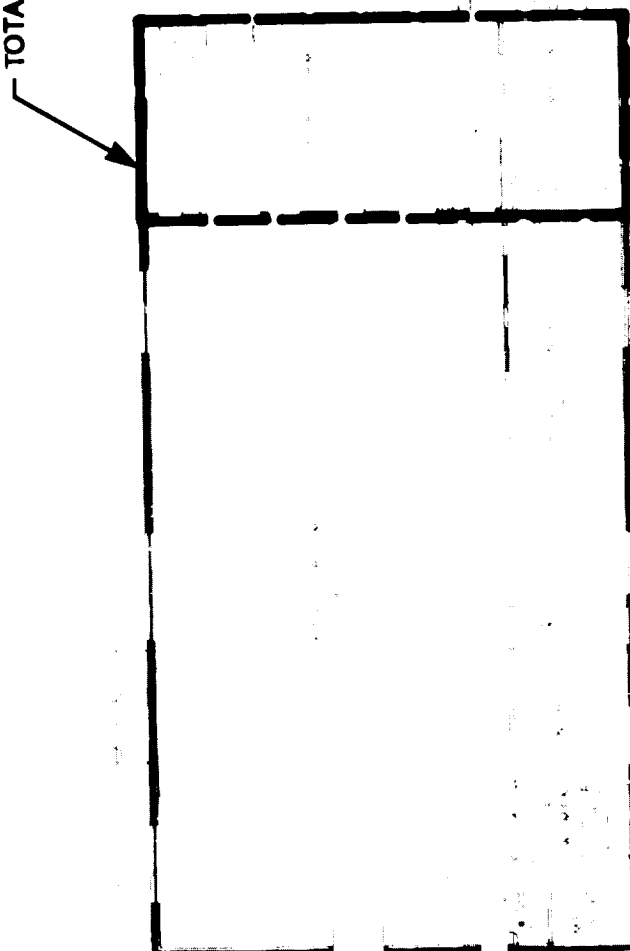


Figure 32. Mars Site: Roofing Material of Operations Support Building G-86.

5. Mojave Base Site: A plot plan of the Mojave Base Site is depicted in Figure 33

a. Building M-6 (Figure 34)

Building M-6, once known as the Telemetry Building, now is used as a vehicle and equipment maintenance facility. It contains a vehicle-repair bay, electrical and mechanical shops, and offices.

Building M-6 has roof-mounted, air-handling equipment with pipes and pipe fittings that were insulated with friable asbestos-containing materials. There were four roof-penetrations insulated with asbestos-containing materials and sealed with tar.

The roof-mounted units were isolated during the asbestos-abatement work, and their asbestos-containing insulation was removed and replaced with non-asbestos-containing insulation. The heating/cooling system was shut down and the rooms supplied by the air handlers were isolated during the friable asbestos-abatement work.

b. Building M-9 (Figure 35)

Building M-9, a Generator Building, houses four diesel generators that contained friable asbestos insulation encased in metal jacketing. There are four wall penetrations leading from the generators. The asbestos insulation in the metal jacketing was removed and replaced, and the wall penetrations were resealed and reinsulated after the asbestos-containing insulation encircling each wall penetration was removed.

Because the generator room could be isolated from other areas of Building M-9, the asbestos-abatement work proceeded without the evacuation of the occupants of the building. Of course, the generators were shut down during the asbestos-abatement work.

G. ADDITIONAL FRIABLE ASBESTOS-ABATEMENT WORK AT THE GDSCC

In addition to the removal of friable asbestos from some rooms (interiors) of 10 building/structures, the asbestos-abatement crew also removed friable asbestos insulation from three water supply pipes that are exterior to Buildings G-22 and G-27 (Echo Site, Figures 36 and 37, respectively), and from Building G-58 (Venus Site, Figure 38). A typical illustration of such pipes BEFORE friable asbestos removal is depicted in Figure 39.

H. GLOVE-BAG TECHNIQUE USED IN REMOVAL OF FRIABLE ASBESTOS

As with the removal of friable asbestos from the interiors of the 10 building/structures, the removal of the friable asbestos insulation from the three exterior pipes, mentioned in Section VI, G, was accomplished using the glove-bag technique (Figure 40). At Building G-22, the Fire Line Pump House, the exterior pipe (see Figure 39) first was surrounded by a mini-enclosure unit before the glove-bag removal technique was used.

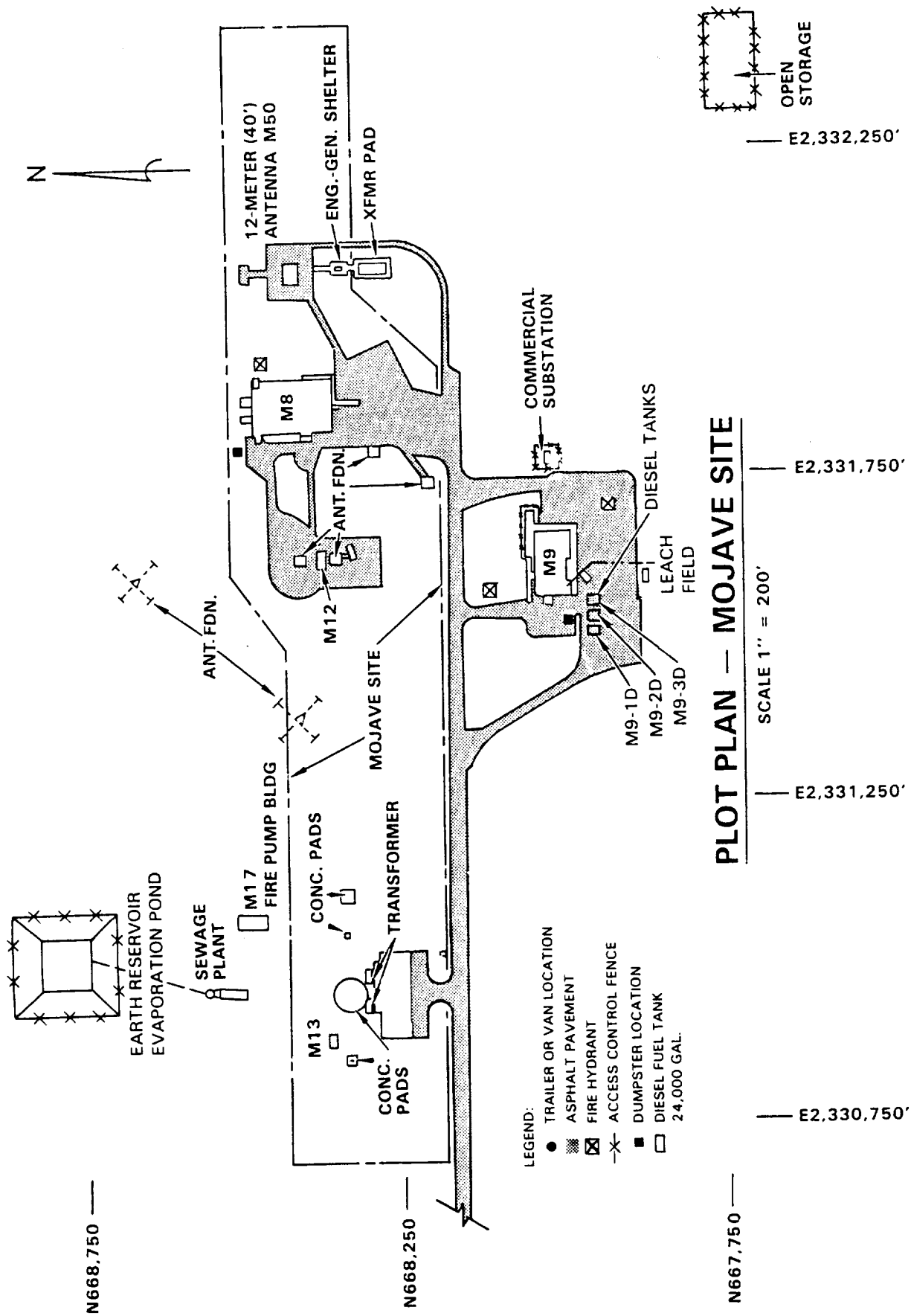


Figure 33. Mojave Base Site: Plot Plan.

Building M-6 (Mojave Base Site)

GENERAL BUILDING INFORMATION

Map grid location: N 667,900/E 2,329,500
Construction date: NOT AVAILABLE
Building type: Cement/cement block
Number of floors: 1
Total floor area (SF): 4729
Building use: TELEMETRY
Summary of asbestos use (Bldg M-6): Floors, pipelines (exterior), roofing

PIPELINES (Reference AA)

Location of pipes: ROOF
Pipe diameter with insulation (in.): 3.00
Insulation thickness (in.): 0.750
Approximate pipe length (LF): 24.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Undisturbed
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: None
Ventilation: Natural
Accessibility to area: 8-ft ladder
Obstructions to area: None
Physical disturbances: Normal vibrations from fans, closing doors, noise, etc
Presence of sensitive equipment: Yes
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: PIPE CONNECTS A/C UNIT ON ROOF. THERE ARE FOUR UNITS ON THE ROOF. SEE FIGURE 34.

EXTERIOR SIDING/ROOF MATERIAL (Reference BA)

Asbestos-bearing material found in: ROOFING
Friable or non-friable: Non-friable
Surface area (SF): 4729
Thickness of material (in.): 0.250
Estimated volume (CF): 99
Condition of material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: None
Building use near asbestos: Support
Work population: None
Ventilation: Natural
Accessibility to area: 8-ft ladder

Building M-6 (Mojave Base Site) (Cont'd)

Obstructions to area: Permanent equipment/furnishings/structures
Physical disturbances: Normal vibrations from fans, closing doors, noise, etc.
Presence of sensitive equipment: No
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ROOF MATERIAL COVERED WITH TAR AND GROUND PEBBLES. SEE FIGURE 34.

FLOORING MATERIALS (Reference GA)

Asbestos-bearing material found in: 9 X 9 in. TILE
Friable or non-friable: Non-friable
Surface area (SF): 778
Thickness of material (in.): 0.125
Estimated volume (CF): 8
Condition of material: Undisturbed
Types of coatings present: None
Building use near asbestos: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: Within normal reach
Obstructions to area: None
Physical disturbances: None
Presence of sensitive equipment: No
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: 9 X 9 in. WHITE TILE WITH GRAY STREAKS. SEE FIGURE 34.

Building M-9 (Mojave Base Site)

GENERAL BUILDING INFORMATION

Map grid location: N 668,000/E 2,331,650
Construction date: NOT AVAILABLE
Building type: Cement/cement block
Number of floors: 1
Total floor area (SF): 5911
Building use: GENERATOR
Summary of asbestos use (Bldg M-9): Floors

FLOORING MATERIALS (Reference GA)

Asbestos-bearing material found in: 9 X 9 in. TILE
Friable or non-friable
Surface area (SF): 1344
Thickness of material (in.): 0.125
Estimated volume (CF): 14
Condition of material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: None
Building use near asbestos: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: Within normal reach
Obstructions to area: Permanent equipment/furnishing/structures
Physical disturbances: Normal vibrations from fans, closing doors, noise, etc.
Presence of sensitive equipment: Yes
Suggested abatement timing: At time of demolition
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: 9 X 9 in. WHITE TILE WITH GRAY STREAKS. SEE FIGURE 35.

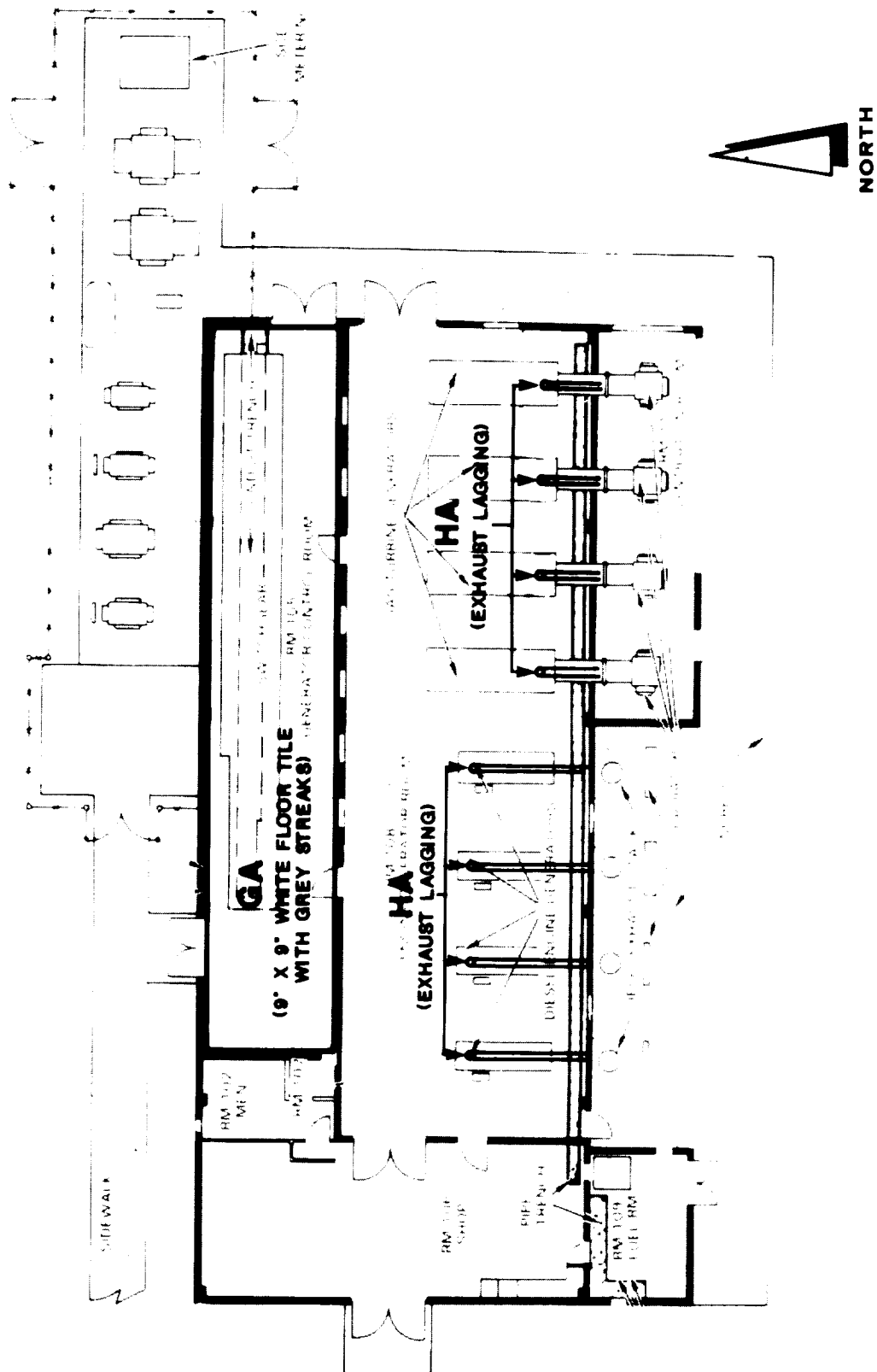


Figure 35. Mojave Base Site: Generator Building M-9.

Building G-22 (Echo Site)

GENERAL BUILDING INFORMATION

Map grid location: N 657,650/E 2,356,200
Construction date: 1971
Building type: Cement/cement block
Number of floors: 1
Total floor area (SF): 350
Building use: FIRE LINE PUMP HOUSE
Summary of asbestos use (Bldg G-22): Pipelines (exterior)

PIPELINES (Reference AA)

Location of pipes: East side of building
Pipe diameter with insulation (in.): 12
Insulation thickness (in.): 1.5
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: Within normal reach
Obstructions to area: None
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW HAS HARD CEMENTITIOUS MATERIAL WITH SOME ADDITIONAL USE EXTENDING AWAY FROM THE ELBOW. SEE FIGURE 36.

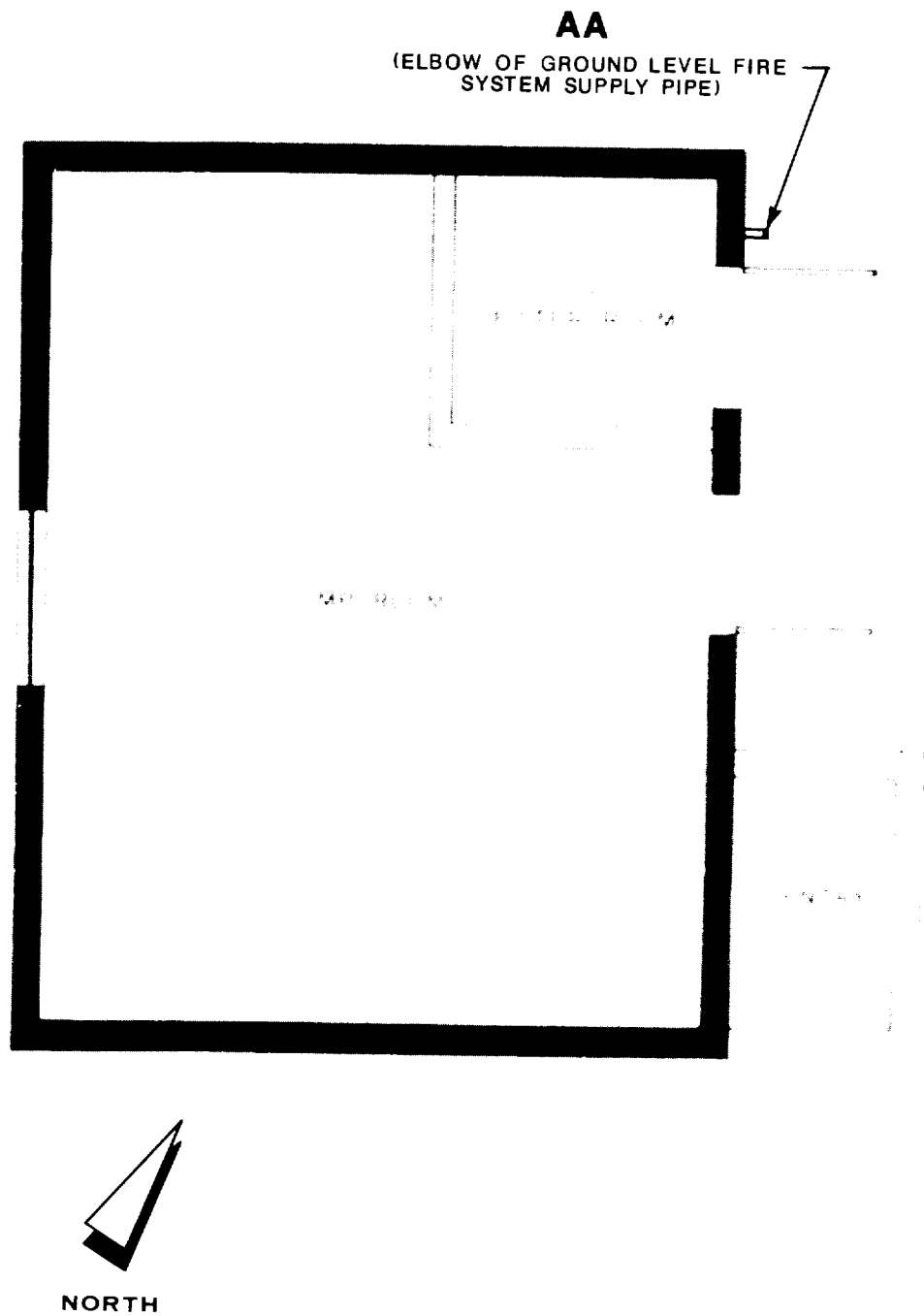


Figure 36. Echo Site: Fire Line Pump House G-22.

Building G-27 (Echo Site)

GENERAL BUILDING INFORMATION

Map grid location: N 657,500/E 2,357,000
Construction date: 1958
Building type: Butler type
Number of floors: 1
Total floor area (SF): 2,016
Building use: OFFICE/STORAGE
Summary of asbestos use (Bldg G-27): Pipelines (exterior)

PIPELINES (Reference AA)

Location of pipes: West side of building
Pipe diameter with insulation (in.): 12
Insulation thickness (in.): 1.5
Approximate pipe length (LF): 1.00
Estimated insulation volume (CF): 1.00
Condition of lagging material: Some physical damage (scuffs, tears, bruises)
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: Within normal reach
Obstructions to area: None
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW HARD CEMENTITIOUS MATERIAL WITH SOME ADDITIONAL USE
EXTENDING AWAY FROM THE ELBOW. SEE FIGURE 37.

AA
(ELBOW OF GROUND LEVEL FIRE
SYSTEM SUPPLY PIPE)

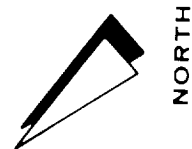


Figure 37. Echo Site: Office and Storage Building G-27.

ORIGINAL PAGE IS
OF POOR QUALITY

Building G-58 (Venus Site)

GENERAL BUILDING INFORMATION

Map grid location: N 638,000/E 2,361,100
Construction date: 1958
Building type: Cement/cement block
Number of floors: 1
Total floor area (SF): 960
Building use: 9-METER HYDRO-MECHANICAL/TRANSMITTER BUILDING
Summary of asbestos use (Bldg G-58): Pipelines (exterior)

PIPELINES (Reference AA)

Location of pipes: EAST SIDE OF BUILDING
Pipe diameter with insulation (in.): 12
Insulation thickness (in.): 1.5
Approximate pipe length (LF): 1.00
Estimated insulation volume: (CF) 1.00
Condition of lagging material: Undisturbed
Types of coatings present: Cloth covering
Building use near pipes: Industrial maintenance
Work population: 1-10
Ventilation: Natural
Accessibility to area: Within normal reach
Obstructions to area: None
Physical disturbances: Physical abuse (scuffing, tearing, bruising, etc.)
Presence of sensitive equipment: No
Suggested abatement timing: In the near future
Suggested abatement method: Removal
Suggested airborne monitoring: None required under normal conditions

Comments: ELBOW OF HARD CEMENTITIOUS MATERIAL. SEE FIGURE 38.

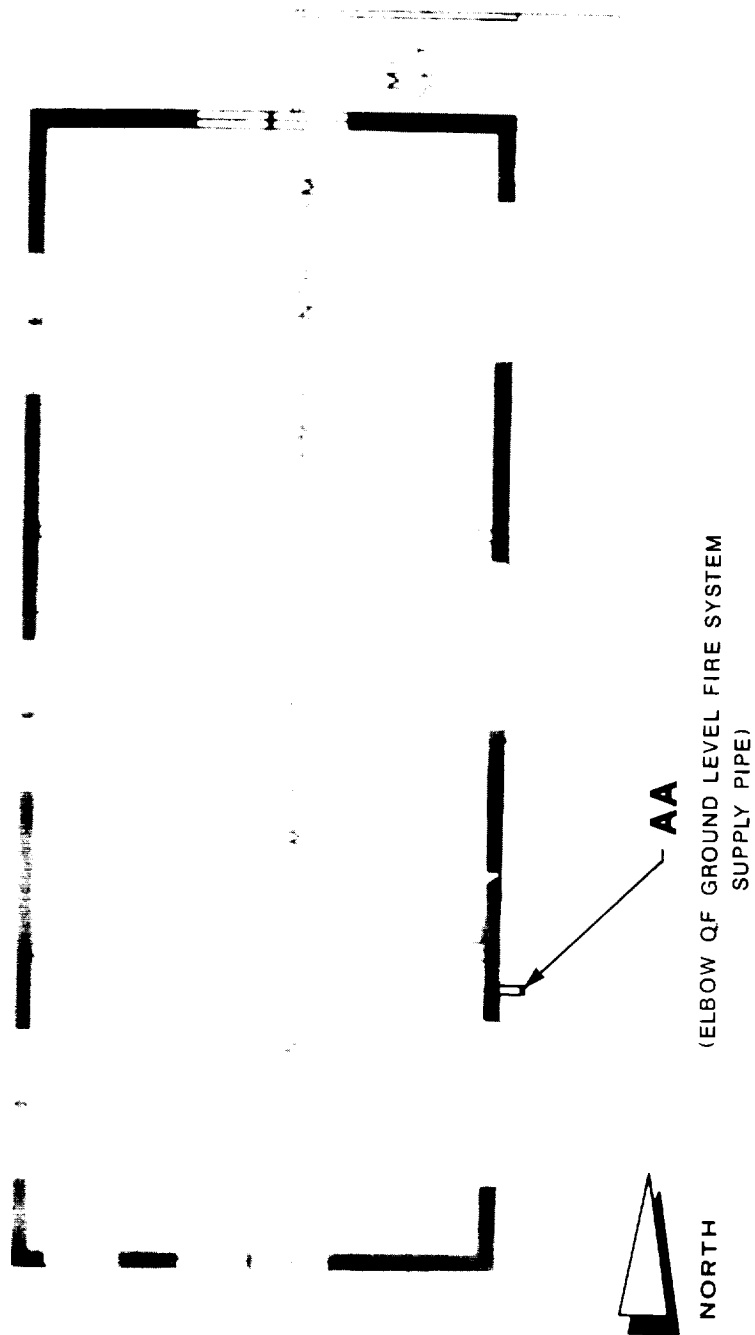


Figure 38. Venus Site: 30' Hydro-Mech and Transmitter Building G-58.

ORIGINAL PAGE IS
OF POOR QUALITY

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH



Figure 39. Echo Site: Asbestos-Containing Insulation around Fire System Water Supply Pipe Exterior to Fire Line Pump House G-22. G-22 has Typical Asbestos-Containing Insulation Covering Exterior Pipes that Enter or Leave Buildings G-22, G-27, G-38, G-58 and M-6 at the GDSCC.

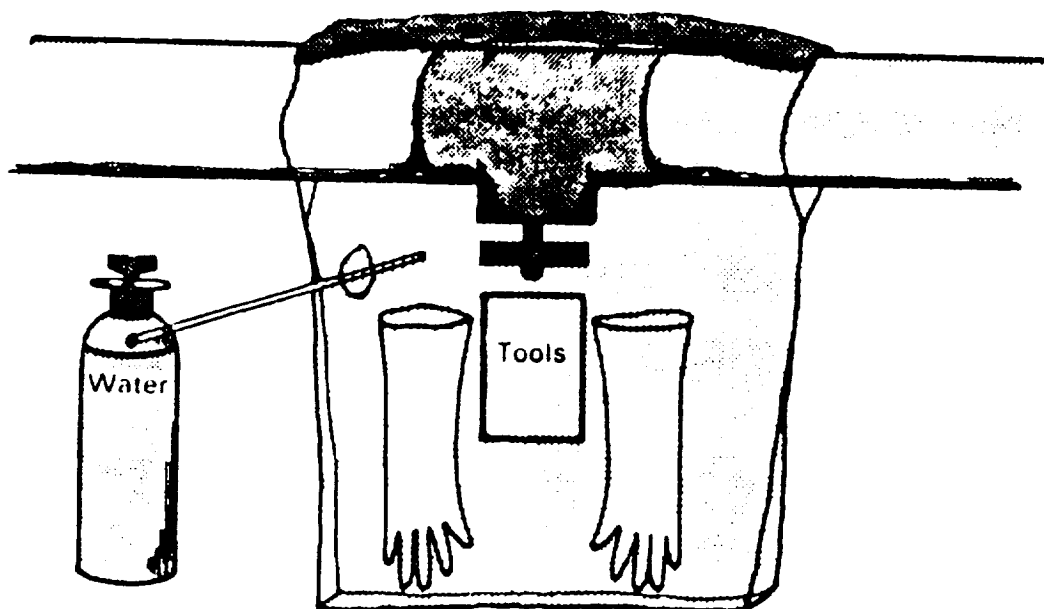


Figure 40. Illustration of "Glove Bag" Apparatus used in the Removal of Small Areas of Asbestos.

The vast majority of friable asbestos-containing material found at the GDSCC during the October 1986 through November 1986 survey by M. B. Gilbert Associates was used to insulate pipes (wrapping) and boilers (jacketing). Asbestos-containing pipe insulation may take several forms, including chalky mixtures of magnesia and asbestos, preformed fibrous asbestos wrapping, asbestos fiber felt, corrugated paper, and insulating cement. In most cases, the insulating material is covered with a protective covering (lagging) made of cloth, tape, paper, metal or cement. Most of the asbestos-containing pipe insulation identified at the GDSCC was a chalky mixture of magnesia and asbestos wrapping covered with a protective cover of cloth.

To remove smaller quantities of pipe insulation, typical of conditions at the GDSCC, containment "glove bags" with sealed holes for hand access are alternatives to full-room or full-work area containment. As shown in Figure 40, these bags are positioned around the pipe insulation and sealed to the pipe with tape. Armholes and an inside pouch for tools let the worker remove insulation without exposure to asbestos fibers. A sealed side port can also be constructed to allow access for wetting the asbestos and evacuating the bag with a HEPA-filtered vacuum. Glove bags are available commercially.

All asbestos-containing material removed during the abatement program was double-bagged, labeled, and disposed of in accordance with Federal, state, and local regulations. Replacement of removed insulation with non-asbestos insulation (Armaflex and/or fiberglass) was done by the asbestos abatement contractor.

I. PHASE CONTRAST MICROSCOPY USED TO COUNT ASBESTOS FIBERS IN AIR SAMPLES BEFORE, DURING, AND AFTER FRIABLE-ASBESTOS REMOVAL

Before friable-asbestos abatement work began at the 10 building/structures designated for friable-asbestos removal at the GDSCC, air samples were taken in each of the rooms from which friable asbestos was to be removed. This was to establish a baseline reading of number of asbestos fibers/cubic centimeter.

Similar air sampling was carried out during and after the friable asbestos was removed.

The technique used to count asbestos fibers in the air samples is designated by the National Institute for Occupational Safety and Health (NIOSH) as Physical and Chemical Analytical Method No. 7400. Because asbestos fibers are transparent when viewed under traditional optical microscopes, and are difficult to see because of lack of contrast, Analytical Method No. 7400 calls for the use of a phase contrast microscope.

The phase contrast microscope, which makes transparent objects visible, was developed in 1935 by Frits Zernike, a Dutch astronomer/physicist, who was awarded the Nobel Prize in Physics in 1953 for his discovery.

The phase contrast microscope makes use of the fact that asbestos fibers have a refractive index (RI) greater than 1.0. The RI is defined as the ratio of the velocity of light in a vacuum (taken as 1.0) to the velocity of light through an asbestos fiber. Because light travels more slowly through an asbestos fiber than it does in a vacuum, the RI of an asbestos fiber is greater than 1.0.

Because the light is slowed as it goes through an asbestos fiber, the light that emerges from the asbestos fiber is slightly out of phase with the light that did not go through the asbestos fiber. The phase contrast microscope converts these phase differences to differences in brightness and creates enough contrast to be able to see the asbestos fibers.

J. POST-ABATEMENT PROTECTION OF GDSCC EMPLOYEES, FOLLOWING THE REMOVAL OF FRIABLE ASBESTOS

On January 1, 1989, a new law (AB 3713), proposed by the California Legislature, became effective. It requires the owner or agents of buildings constructed prior to 1979 (this includes most GDSCC buildings) to notify their individual employees in writing about the presence and possible health impacts of any asbestos-containing materials in the pertinent buildings.

Thus, to comply with this new law after the friable asbestos was removed from the GDSCC, James E. McPartland, Manager of the GDSCC, sent a letter entitled "Asbestos Awareness" to all GDSCC personnel. The letter, dated June 16, 1989, mentions the two asbestos surveys at the GDSCC, the 33 buildings/structures where non-friable asbestos containing materials are found, and indicates general instructions how to handle the non-friable asbestos-containing materials.

Along with the letter was an Acknowledgment Sheet that would verify that the individual employee had received and read the letter.

The Acknowledgment Sheet was to be signed by each employee and his/her immediate supervisor, and it was to be returned to the GDSCC Environmental Protection Office by a specific date.

A copy of the letter and the Acknowledgment Sheet is presented in Appendix F.

SECTION VII
CERTIFICATION

I hereby certify that all engineering work overseen by Engineering-Science, Inc., Pasadena, California, and its subcontractors, in the asbestos abatement program to remove friable asbestos from the Goldstone Complex of the Fort Irwin Military Reservation, San Bernardino County, California, as described in this report, was performed in compliance with Federal, state, and local regulations, and in accordance with good engineering and investigative practice.

Leonard H. Kushner
Registered Professional Engineer

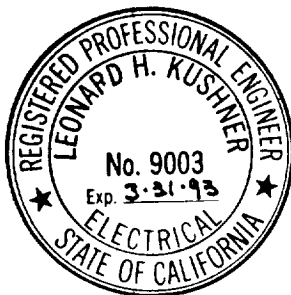
Signature Leon Kushner

Date Signed June 15, 1990

Registration No. E9003 Electrical
SF1086 Safety
REA0078 Environmental
Assessor

State: California
California
California

Stamp/Seal



APPENDIX A

TERMINOLOGY AND DEFINITIONS OF WORDS AND TERMS
ASSOCIATED WITH ASBESTOS IN THE ENVIRONMENT

Abatement: Procedures, including encapsulation, enclosure, and removal, that are used to control fiber release from asbestos-containing building materials.

Airlock: A system for permitting ingress or egress without allowing air movement between a contaminated area and an uncontaminated area. It typically consists of two curtained doorways at least 6 feet apart.

Air Monitoring: A process to measure the asbestos fiber content of a specific volume of air in a stated period of time.

Amended Water: Water to which a surfactant has been added.

Area Monitoring: Sampling of asbestos fiber concentrations within the asbestos control area and outside the asbestos control area. This sampling represents the airborne concentrations of asbestos fibers that may reach the breathing zone.

Asbestos: Includes the minerals chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite.

Asbestos Material: Asbestos or any asbestos-containing material, including pipe and boiler insulation, roofing and siding insulation, fireproofing, or asbestos cement products.

Asbestos Control Area: An area where asbestos removal operations are being performed. It is isolated by physical boundaries to prevent the spread of asbestos dust, fibers, or debris.

Asbestos Fibers: Refers to asbestos fibers longer than 5 micrometers (μm).

Authorized Visitor: Any visitor to the site whose visit has been authorized by the Contracting Officer and/or is a representative of a cognizant regulating agency that has jurisdiction over the project.

Clean Room: An uncontaminated area or room that is part of the worker decontamination enclosure system. It has provisions for storage of workers' street clothes and protective equipment.

Concealed Spaces: Spaces between a suspended ceiling and floor construction above, or between double walls or furred-in areas (i.e., pipe and duct shafts, loft areas, attics bounded by drywall ceilings, etc.).

Curtained Doorway: A device to allow ingress or egress from one room to another while permitting minimal air movement between the rooms. It is typically constructed by placing two overlapping sheets of plastic over an existing or temporarily framed doorway, securing each sheet along the top of the doorway, and securing the vertical edge of the other sheet along the opposite vertical side. Two curtained doorways spaced a minimum of 6 feet apart form an airlock.

Decontamination Enclosure System: A series of connected rooms, with curtained doorways between any two adjacent rooms, for the decontamination of workers or of materials and equipment. A decontamination enclosure system always contains at least one airlock.

Dust-Free: All surfaces and crevices free of all visible dust.

Encapsulant (Sealant): A liquid that can be applied to asbestos-containing materials. It controls the possible release of asbestos fibers from the material either by creating a membrane over the surface (bridging encapsulant) or by penetrating into the material and binding its components together (penetrating encapsulant).

Encapsulation: A process necessary to coat all spray- or trowel-applied asbestos-containing materials with an encapsulant to control the possible release of asbestos fibers into the ambient air.

Equipment Decontamination Enclosure System: A decontamination enclosure system for materials and equipment that typically consists of a designated portion of work area, a washroom, a holding area, and an uncontaminated area.

Equipment Room: A contaminated area or room that is part of the worker decontamination enclosure system. It has provisions for storage of contaminated clothing and equipment.

Exposed: Open to view. A pipe run through a room and not covered by construction is exposed.

Finished Spaces: Spaces used for habitation or occupancy where rough surfaces are plastered, paneled, or otherwise treated to provide a pleasing appearance.

Fixed Object: A unit of equipment or furniture in the work area that cannot be removed from the work area.

Friable Asbestos Material: Material that contains more than one-percent asbestos by weight and that can be crumbled, pulverized, or reduced to powder by hand pressure when dry.

HEPA Filter: A high-efficiency particulate air (absolute) filtered vacuuming equipment with a filter system capable of collecting and retaining asbestos fibers. Filters should be 99.97 percent efficient for retaining fibers of 0.3 μm or larger.

Holding Area: A chamber between an uncontaminated area and the washroom in the equipment decontamination facility. The holding area comprises an airlock.

Jacketing: The outer covering of insulation material used on boilers and steam vessels. The term commonly is used to mean both the outer covering and the insulating material itself.

Lagging: The outer covering of insulating materials used on steam and hot water pipes. It may be cloth, metal or paper. The term commonly is used to mean both the outer covering and the insulating material itself.

Movable Object: A unit of equipment or furniture in the work area that can be removed from the work area.

Negative Pressure: A local exhaust system capable of maintaining a minimum pressure differential of minus 0.02 inch of water column relative to adjacent unsealed areas.

Non-Friable Asbestos Material: Material that contains asbestos in which the fibers have been locked in by a bonding agent, coating, binder, or other material so that the asbestos is well bound and during any appropriate use will not release fibers in excess of the asbestos control limit.

Permissible Exposure Limit (PEL): The 8-hour time-weighted average concentration of airborne asbestos fibers to which any employee may be exposed shall not exceed 0.2 fibers, longer than 5 micrometers, per cubic centimeter of air as determined by the membrane filter method using phase contrast illumination of 400 to 450 X magnification.

Personal Monitoring: Air sampling of asbestos fiber concentrations within the breathing zone of an employee.

Qualified Industrial Hygienist: An industrial hygienist who is experienced in asbestos-abatement procedures and who works under the direct supervision of an industrial hygienist certified by the American Board of Industrial Hygiene (ABIH).

Qualified Laboratory: A laboratory that has been judged proficient in the counting of asbestos fibers by successful participation in the National Institute for Occupational Safety and Health (NIOSH) Proficiency Analytical Testing (PAT) Program.

Removal: All removal procedures strip all asbestos-containing materials from the designated areas and dispose of these materials at an acceptable site.

Shower Room: A room between the clean room and the equipment room in the worker decontamination facility. It has hot and cold or warm running water and is suitably arranged for complete showering during decontamination. The shower room comprises an airlock between contaminated and clean areas.

Surfactant: A chemical wetting agent added to water to improve penetration. This reduces the quantity of water required to sufficiently moisten asbestos material for its removal.

Time-Weighted Average (TWA): The TWA is an 8-hour time-weighted average airborne concentration of fibers per cubic centimeter of air. The measurement involves fibers that are longer than 5 micrometers.

Transite: A cementitious, non-friable, asbestos-cement material commonly used for building sidings, walls, panels, etc., as well as water-distribution pipelines.

Washroom: A room between the work area and the holding area in the equipment decontamination enclosure system. The washroom comprises an airlock.

Wet Cleaning: A process of eliminating asbestos contamination from building surfaces and objects by using cloths, mops, or other cleaning tools that have been dampened with water. These cleaning tools are disposed of afterwards as asbestos-contaminated waste. Streaking caused by wiping down is not acceptable.

Work Area: Area or room where asbestos material is present including the ceilings, walls, floors, fixed items, etc.

Worker Decontamination Enclosure System: A decontamination enclosure system for workers, typically consisting of a clean room, a shower room, and an equipment room.

APPENDIX B

NASA OCCUPATIONAL HEALTH OFFICE GUIDELINES (1983)
FOR ASBESTOS HAZARD-ASSESSMENT AND ABATEMENT



National Aeronautics and
Space Administration

Washington, D.C.
20546

NPG-34
NX-2

February 18, 1983

TO: Distribution

FROM: NPG-34/Director, NASA Occupational Health Office
NX-2/Director, Facilities Division

SUBJECT: Hazard Assessment and Abatement of Asbestos in NASA Buildings

A NASA-wide project was initiated some time ago to determine the extent of asbestos-containing materials, particularly spray-applied insulation (SAI), in work spaces throughout the Agency. Buildings and locations that contained potentially hazardous sources of friable asbestos were identified, bulk insulation samples were collected, and the samples were analyzed for asbestos.

The results showed that asbestos is present in a variety of different materials at NASA. It was found to be present in SAI on surfaces of ceilings, plenums, walls, and structural steel. About three-fourths of the samples submitted for analysis contained asbestos. This represented eighty-one buildings and approximately four and one-half million square feet of insulation material. The condition of the SAI was visually assessed and most of the insulation was reported to be in good condition. Sixty-five percent of the locations were reported to have had no damage; thirty percent had minor damage; and five percent had significant damage. Corrective action has already been taken with regard to most of the damaged insulation that was found.

Even though we have a considerable amount of SAI that contains asbestos in our buildings, concerted abatement efforts such as enclosure, encapsulation, and removal are not warranted simply because of the presence of the material. There is no evidence that spray-applied insulation which is intact and in good condition poses a danger to the health of employees.

Our position with respect to the presence of asbestos in NASA facilities is summarized as follows:

- Asbestos SAI should not be removed from surfaces of NASA buildings simply because of its presence, nor should other abatement techniques be implemented.
- All areas containing asbestos SAI should be visually inspected at least annually for damage and signs of deterioration.

- Air sampling and analysis for airborne fibers should be performed annually, or more frequently as warranted, in areas containing asbestos SAI.
- Where hazard assessments reveal asbestos SAI to be in unacceptable condition-so that the health of building occupants is threatened, corrective actions should be promptly taken to eliminate or control the source of contamination. An "unacceptable condition" exists when the release of asbestos fibers from SAI and other sources results in airborne concentrations in excess of 0.1 fiber per cubic centimeter of air or when inspections reveal the material to be in a bad state of repair (dislodged, deteriorating, severely damaged, falling, etc).
- Medical examinations in accordance with the OSHA asbestos standard criteria (29 CFR 1910.1001) should be provided for employees routinely engaged in asbestos removal or repair (i.e., insulators), employees who frequently enter or work in contaminated areas (i.e., plenum spaces), anyone exposed for 7-8 hours to a time-weighted average concentration of 0.1 fiber per cubic centimeter of air or greater, and those who have had significant exposures to asbestos in the past.
- Accurate and up-to-date records should be maintained of all asbestos identification, work area surveillance, and abatement activities. Employees should have access to these records in accordance with OSHA requirements. Access to medical surveillance records shall be in accordance with NASA Privacy Regulations on Medical Records.

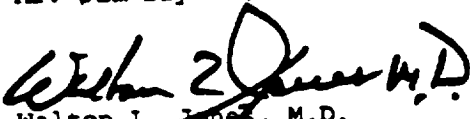
Guidelines and other information relative to visual inspection and air sampling and analysis are provided in Appendix A. Abatement methods are discussed in Appendix B.

The initial phase of the NASA asbestos project was primarily devoted to SAI; however, asbestos is also present in pipe and boiler lagging, cementous asbestos products (i.e., pipe and siding), friction materials, etc. Steps should be taken to ensure that any contamination and subsequent exposures resulting from the presence, handling, and use of all asbestos materials are adequately controlled. Any work involving asbestos must be appropriately coordinated and carefully monitored to ensure conformity with regulatory requirements, prevent personnel exposures, preclude building contamination, and minimize unnecessary costs and delays. Some guideline procedures pertinent to the handling and use of asbestos are provided in Appendix C.

This effort should be coordinated between facilities, medical and environmental health personnel. Each group should be responsible for performing those activities in which it has expertise. Jointly, they should develop local policies or procedures to ensure proper control of asbestos-related activities; select the most feasible and efficient abatement techniques; ensure that OSHA and EPA regulations (29 CFR 1910.1001 and 40 CFR 61.20-61.25, respectively) are

followed; and maintain records of activities, findings, and corrective actions involving asbestos. Top management, legal personnel, employee representatives, and others as appropriate should be kept informed of pertinent findings and developments.

A useful publication that was prepared at the Lewis Research Center is attached to this document as Enclosure 1 for additional information on asbestos. Any questions relative to this project should be directed to Mr. Jim Bayne (FTS 755-3647) or Mr. Gene Proctor (FTS 755-2077).


Walton L. Jones, M.D.


Billie J. McGarvey

Enclosures

Please note that Appendix A, B, and C to this letter are not included in this volume.

APPENDIX C

LETTERS AND DISCLAIMERS, SENT FROM M. B. GILBERT ASSOCIATES
TO THE JET PROPULSION LABORATORY,
THAT ACCOMPANIED SUBMITTED REPORTS DESCRIBING
THE TWO ASBESTOS FIELD SURVEYS CONDUCTED AT
THE GOLDSTONE COMPLEX

M.B. GILBERT ASSOCIATES

ENVIRONMENTAL ENGINEERING SERVICES • 2525 Cherry Ave., Suite 380, Long Beach, CA 90806 • 213/426-0700 • Telefax 213/492-1320

April 20, 1987
File No. 71031.01

Mr. Len Kushner
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, CA 91109

Subject: Submittal of Asbestos Survey and Management/Abatement Plan, Contract No. 957527, and Disclaimer Regarding the Asbestos Survey.

Dear Mr. Kushner:

Please find enclosed herein five copies of the subject report. Also enclosed are copies of diskettes containing the text of the report and mylars of the drawings.

The asbestos survey conducted by M. B. Gilbert Associates (MBGA) at Goldstone Deep Space Communications Center (GDSCC) identifies the general locations and provides approximate quantities of friable and non-friable asbestos-containing materials in buildings and structures. As seen from a review of this report the survey team was as thorough as possible in its investigation; however, it is possible that some existing asbestos-containing material was not found. The primary reasons for failure to find existing asbestos-containing materials are as follows:

- 1) The asbestos-containing material is substantially inaccessible, e.g., within walls, crawl spaces, trenches, roof structures. MBGA suggests that due care be taken during demolition or remodeling operations to confirm the presence of such hidden asbestos-containing materials and measures be taken for protecting potentially exposed workers.
- 2) The asbestos-containing material is a relatively small portion of an equipment, appliance, or structure item. For example, heating elements may have interior asbestos material lining, valve glands may have asbestos and graphite packing, etc. It would be impractical, if not impossible, to identify such items individually. Again, in virtually

all such cases the asbestos-containing material does not pose an existing hazard to personnel because it is non-friable, enclosed, and of small quantity. However, it is recommended that the purchasing department stipulate to suppliers that future purchases will not include asbestos-containing material and that persons performing maintenance on such items be warned of the potential existence of asbestos.

- 3) The asbestos-containing material is underground, e.g., buried pipe lines, old demolition disposal sites or landfills, etc. Such materials pose no existing hazard to base personnel, unless exposed at the time excavation. (There is, however, a growing concern that transite water pipes may release asbestos into the water supply.) Construction/maintenance/inspection personnel should be aware of asbestos hazards at potential or known burial sites; and GDSCC should ensure that proper precautions are taken if old pipe lines or demolition materials are uncovered which may contain asbestos.
- 4) The asbestos-containing material may be concealed beneath newly installed non-asbestos pipe or boiler wrapping. GDSCC staff assured MBGA staff that no asbestos-wrapped piping had been replaced by non-asbestos wrap prior to the survey.
- 5) Due to the size, number, and complexity of buildings and structures at GDSCC, some small or remote occurrences of asbestos-containing material may have been overlooked through human error.
- 6) The investigators were unable to enter certain areas at GDSCC because keys were not available or because equipment was in use preventing access. These areas are identified in the subject report.
- 7) A fixed number of samples were collected for analysis. Although a sufficient number of samples and reference blanks were collected, it is possible, although remote, that asbestos was not present in a sample, but was present in the item from which the sample was taken. Also, several vinyl tile floors had numerous vintages of replacement tiles present. Samples of selected existing and replacement tiles were collected, but each replacement tile was not sampled.

Mr. Len Kushner
April 20, 1987
Page 3

Reasonable care and diligence was used during the investigation to identify all significant potential and existing asbestos hazards. However, as explained above, some additional asbestos-containing materials undoubtedly exist which were not identified.

If you have any questions regarding this disclaimer or the MBGA subject report, please do not hesitate to contact me.

Very truly yours,

M.B. GILBERT ASSOCIATES

A handwritten signature in cursive script that reads "Marsha Beck Gilbert".

Marsha Beck Gilbert
President

MBG:rbb

M.B. GILBERT ASSOCIATES

ENVIRONMENTAL ENGINEERING SERVICES • 2525 Cherry Ave., Suite 380, Long Beach, CA 90806 • 213/426-0700 • Telefax: 213/492-1320

October 29, 1987
File No. 71031.08

Mr. Len Kushner
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, CA 91109

Subject: Submittal of Asbestos Survey of Roofs and Boilers at Goldstone Deep Space Communication Complex, Contract No. 957527, Modification 4, and Disclaimer Regarding the Asbestos Survey.

Dear Mr. Kushner:

Please find enclosed herein three copies of the subject report. Also enclosed are copies of diskettes containing the text of the report and mylars of the drawings.

The asbestos survey conducted by M.B. Gilbert Associates (MBGA) at Goldstone Deep Space Communications Center (GDSCC) identifies the general locations and provides approximate quantities of friable and non-friable asbestos-containing materials in specified roofs and boilers at GDSCC. While the survey team sampled for asbestos in all specified locations, there is the remote possibility that inconsistencies in the distribution of asbestos fibers in insulating materials could result in a negative finding for any particular sample analyzed. To minimize this possibility, corings of roofing materials were taken through the entire thickness of roof present, several samples were taken of each roof, and several replicate samples were taken of roofs and boilers for double blind testing by the laboratory. Reasonable care and diligence was used during the investigation to obtain representative samples.

In the subject report, MBGA discusses the dissolution of Cal/OSHA. This condition resulted from the intentional failure of the governor to reauthorize funding for the agency. The legality of the governor's action is being challenged in court, with the potential for reinstatement of the Cal/OSHA budget. MBGA advises GDSCC personnel to follow this issue until it is resolved, since reactivation of the agency would result in a change in procedural requirements for asbestos management.

Mr. Len Kushner
October 29, 1987
Page Two

If you have any questions regarding this disclaimer or the MBGA subject report, please do not hesitate to contact me.

Very truly yours,

M.B. GILBERT ASSOCIATES

A handwritten signature in cursive script, reading "Marsha Beck Gilbert". The signature is written in black ink and is positioned above the printed name and title.

Marsha Beck Gilbert
President

APPENDIX D

BUILDING-BY-BUILDING SAMPLE RESULTS
OF ASBESTOS SURVEY AT THE GDSCC/BARSTOW

Table D-1. Laboratory Results by Building Number

Building Number	Sample Number	% Asbestos	
		Chrysotile	Amosite
PIONEER SITE			
G-6	NO SAMPLES		
G-7	NO SAMPLES		
G-12	NO SAMPLES		
ECHO SITE			
G-21	MB1031G21-AB	ND ^a	ND
	MB1031G21-AC	20	ND
	MB1031G21-AD	1	ND
	MB1031G21-AE	35	ND
	MB1031G21-AEA ^b	25	ND
	MB1031G21-AF	ND	ND
	MB1031G21-AG	20	25
	MB1031G21-AH	ND	ND
	MB0922G21-29	ND	ND
	MB0922G21-30	ND	ND
G-22	MB1029G22-AA	ND	ND
	MB1029G22-EA	ND	ND
G-23	MB1031G23-AA	ND	ND
	MB1031G23-AB	ND	ND
	MB1031G23-ABA ^b	ND	ND
	MB1031G23-AC	ND	ND
	MB1031G23-AD	20	ND
	MB1031G23-ADA ^b	15	2
	MB1031G23-AE	ND	ND
	MB1031G23-AF	20	5
	MB1031G23-AG	ND	ND
	MB1031G23-AH	ND	ND
	MB1031G23-AI	45	ND
	MB1031G23-AJ	ND	ND
	MB1031G23-AK	15	10
	MB1031G23-AL	10	30
	MB1031G23-AM	40	ND
	MB1031G23-AMA ^b	45	ND
	MB1031G23-BA	ND	ND

^aND means no asbestos was detected in the sample. The detection limit is 1% asbestos.

^bThese samples are replicate samples. Replicate samples have identical sample numbers, except that the letter "A" has been added to the end of the identifying number of one of the replicate samples.

Table D-1. (Cont'd)

Building Number	Sample Number	% Asbestos	
		Chrysotile	Amosite
ECHO SITE (Cont'd)			
	MB1031G23-EA	ND	ND
	MB1031G23-GA	5	ND
	MB0917G23-7	ND	ND
	MB0917G23-8	ND	ND
	MB0922G23-27	ND	ND
	MB0922G23-28	ND	ND
G-24	MB0930G24-HA	ND	ND
	MB0930G24-HB	35	ND
	MB0930G24-HC	ND	ND
	MB0930G24-HD	60	ND
	MB0930G24-HE	25	ND
	MB0930G24-HF	ND	ND
	MB1001G24-HG	20	ND
	MB1001G24-HH	30	ND
	MB1001G24-HI	25	ND
	MB0930G24-GA	2	ND
	MB0930G24-GB	2	ND
	MB1001G24-BA	ND	ND
	MB1001G24-BB	ND	ND
	MB1009G24-CC	ND	ND
	MB1001G24-EA	ND	ND
G-25	MB1001G25-GA	ND	ND
	MB1001G25-EA	ND	ND
G-26	RB1010G26-AA	20	5
	RB1010G26-AB	ND	ND
	RB1010G26-AC	15	10
	RB1010G26-AD	ND	ND
	RB1010G26-AE	30	ND
	RB1010G26-AF	ND	ND
	RB1010G26-AG	15	ND
	RB1010G26-AH	ND	ND
	RB1010G26-AI	ND	ND
	RB1010G26-AJ	20	2
	RB1010G26-AK	ND	ND
	RB1010G26-AL	20	5
	RB1010G26-AM	ND	ND
	MB1009G26-CA	ND	ND
	MB1009G26-CAA ^b	ND	ND
	MB1009G26-CB	ND	ND
	MB1009G26-CBA ^b	ND	ND
	RB1010G26-DA	ND	ND
	RB1010G26-DAA ^b	ND	ND

Table D-1. (Cont'd)

Building Number	Sample Number	% Asbestos	
		Chrysotile	Amosite
ECHO SITE (Cont'd)			
	MB1009G26-EA	ND	ND
	MB1009G26-EB	ND	ND
	MB1009G26-GA	ND	ND
	MB1009G26-GB	3	ND
	MB1009G26-GBA ^b	3	ND
	MB1009G26-GC	5	ND
	MB1009G26-GD	<1 ^c	ND
	MB1009G26-HA	ND	ND
	RB1010G26-HB	2	ND
	RB1010G26-HD	30	ND
	MB1010G26-HE	35	ND
	MB1010G26-HEA ^b	30	ND
	MB0917G26-15	<1	ND
	MB0917G26-16	<1	ND
	MB0917G26-17	ND	ND
	MB0917G26-18	5	ND
	MB0922G26-31	ND	5
	MB0922G26-32	ND	ND
	MB0922G26-33	ND	ND
	MB0922G26-33A ^b	ND	ND
	MB0922G26-34	ND	ND
G-27	MB1001G27-EA	ND	ND
	MB0507G27-AA	<1	ND
G-28	MB1001G28-GA	ND	ND
	MB1001G28-CA	ND	ND
G-29	MB0930G29-CA	ND	ND
G-33	MB1031G33-AA	ND	ND
	MB1031G33-AF	ND	ND
	MB1031G33-AG	30	ND
	MB1031G33-AH	ND	ND
	MB1031G33-AI	ND	ND
	MB0508G33-AJ	ND	ND
	MB0508G33-AK	20	ND
	MB0508G33-AL	15	ND
	MB0508G33-AM	ND	ND
	MB0508G33-AMA ^b	ND	ND
	MB0508G33-AN	20	5
	MB0508G33-AO	ND	ND

^cThe symbol <1 indicates trace amounts of asbestos. Less than 1% of asbestos are in these samples.

Table D-1. (Cont'd)

Building Number	Sample Number	% Asbestos	
		Chrysotile	Amosite
ECHO SITE (Cont'd)			
	MB0508G33-AP	25	15
	MB0508G33-AQ	ND	ND
	MB0508G33-AR	25	15
	MB0508G33-AS	ND	ND
	MB0508G33-AT	20	ND
	MB1010G33-EA	ND	ND
	MB1010G33-EB	ND	ND
	MB1010G33-EBA ^b	ND	ND
	MB1010G33-EC	ND	ND
	MB1010G33-GB	2	ND
	MB1010G33-GC	1	ND
	MB1010G33-GD	2	ND
	MB1010G33-GE	3	ND
	MB0917G33-12	ND	ND
	MB0917G33-13	ND	ND
	MB0917G33-14	ND	ND
	MB0922G33-35	ND	ND
	MB0922G33-36	ND	ND
	MB0922G33-37	ND	ND
	MB0922G33-38	ND	ND
	MB0922G33-39	ND	ND
	MB0922G33-40	ND	ND
G-34	MB1031G34-BA	ND	ND
	MB1031G34-EA	ND	ND
G-35	NO SAMPLES		
G-36	MB1031G36-GA	1	ND
G-37	MB1031G37-AC	30	ND
	MB1031G37-AD	40	ND
	MB1029G37-BA	ND	ND
	MB1029G37-EA	ND	ND
	MB1029G37-GA	10	ND
	MB1029G37-HB	ND	ND
G-38	MB1031G38-AA	ND	ND
	MB1031G38-AB	10	ND
	MB1031G38-AC	ND	ND
	MB1031G38-ACA ^b	ND	ND
	MB1031G38-AD	ND	ND
	MB1031G38-AE	ND	ND
	MB1031G38-AF	10	15
	MB0507G38-AF	ND	ND

Table D-1. (Cont'd)

Building Number	Sample Number	% Asbestos	
		Chrysotile	Amosite
ECHO SITE (Cont'd)			
	MB0507G38-AG	25	10
	MB0507G38-AH	20	ND
	MB0507G38-AI	25	15
	MB0507G38-AIA ^b	15	5
	MB0507G38-AJ	15	ND
	MB0930G38-HA	50	ND
	MB0928G38-HB	<1	5
	MB0928G38-HC	20	<1
	MB0917G38-9	ND	ND
	MB0917G38-10	ND	ND
	MB0917G38-11	<1	ND
	MB0922G38-25	ND	5
	MB0922G38-26	ND	ND
G-39	NO SAMPLES		
G-40	NO SAMPLES		
G-41	MB0930G41-CA	ND	ND
	MB0930G41-CB	ND	ND
G-42	MB0930G42-EA	ND	ND
	MB0930G42-CA	ND	ND
	MB0930G42-CB	ND	ND
	MB0930G42-GA	3	ND
	MB0930G42-GB	2	ND
	MB0930G42-GC	2	ND
G-43	MB1029G43-BA	ND	ND
	MB1029G43-CA	ND	ND
	MB1029G43-CAA ^b	ND	ND
	MB1029G43-EA	ND	ND
	MB1029G43-GA	ND	ND
G-44	MB0930G44-CA	25	ND
G-45	MB0930G45-EA	ND	ND
	MB0930G45-EB	ND	ND
	MB0930G45-GA	2	ND
G-46	MB0929STOR1-CA	ND	ND
	MB0929G46-GA	ND	ND
	MB0929G46-HA	25	ND
	MB0929G46-HB	75	ND
	MB0929G46-CA	ND	ND
	MB0929G46-HC	20	ND

Table D-1. (Cont'd)

Building Number	Sample Number	% Asbestos	
		Chrysotile	Amosite
ECHO SITE (Cont'd)			
G-47	MB0930G47-DA	ND	ND
	MB0930G47-GA	<1	ND
	MB0930G47-EA	ND	ND
G-48	NO SAMPLES		
DUMP SITE	MB1031ECHO-HA	ND	ND
	MB1031ECHO-HB	ND	ND
	MB1031ECHO-HC	ND	ND
VENUS SITE			
G-51	MB1028G51-AA	ND	ND
	MB1028G51-AB	5	2
	MB1028G51-AC	ND	ND
	MB1028G51-AD	20	5
	MB1028G51-AE	10	25
	MB1028G51-AF	60	ND
	MB1028G51-CA	15	5
	MB1028G51-CB	ND	ND
	MB1028G51-CBA ^b	ND	ND
	MB1028G51-GA	5	ND
	MB1028G51-HA	ND	ND
	MB0917G51-1	ND	ND
	MB0917G51-2	ND	ND
	MB0922G51-41	ND	ND
	MB0922G51-42	ND	ND
G-52	MB1028G52-CA	ND	ND
G-53A	MB1028G53A-GA	5	ND
G-53B	MB0917G53B-6	ND	ND
G-54	NO SAMPLES		
G-55	MB1028G55-HA	30	ND
	MB1028G55-HB	ND	ND
	MB1028G55-HC	ND	ND
G-56	MB1028G56-GA	5	ND
G-57	NO SAMPLES		

Table D-1. (Cont'd)

Building Number	Sample Number	% Asbestos	
		Chrysotile	Amosite
VENUS SITE (Cont'd)			
G-58	MB0508G58-AA	2	ND
	MB0917G58-5	ND	ND
G-60	MB1028G60-EA	ND	ND
	MB1028G60-GA	ND	ND
	MB0917G60-3	ND	ND
	MB0917G60-4	ND	ND
G-61	NO SAMPLES		
G-63	MB1027G63-CA	ND	ND
	MB1027G63-CAAb	ND	ND
G-67	NO SAMPLES		
AIRPORT SITE			
G-69	NO SAMPLES		
G-70	MB1027G70-BA	5	ND
	MB0127G70-BAA	ND	ND
	MB1027G70-CA	ND	ND
G-71	MB1027G71-GA	10	ND
	MB1027G71-GB	ND	ND
MICROWAVE TEST FACILITY			
G-72	MB1027G72-AA	ND	ND
	MB1027G72-AB	15	15
	MB1027G72-ABAb	20	10
	MB1027G72-AC	ND	ND
	MB1027G72-AD	ND	ND
	MB1072G72-ADAb	ND	ND
	MB1027G72-AE	20	5
	MB1027G72-AF	50	ND
	MB1027G72-AFAb	40	ND
	MB1027G72-AG	ND	ND
	MB1027G72-AH	15	<1
	MB1027G72-AI	ND	ND
	MB1027G72-AJ	15	5
	MB1027G72-AJAb	40	2
	MB1027G72-DA	ND	ND

Table D-1. (Cont'd)

Building Number	Sample Number	% Asbestos	
		Chrysotile	Amosite
MICROWAVE TEST FACILITY (Cont'd)			
	MB1027G72-EA	ND	ND
	MB1027G72-EAA ^b	2	ND
	MB1027G72-EB	ND	ND
	MB1027G72-GB	5	ND
	MB1027G72-GC	3	ND
	MB1027G72-GD	5	ND
	MB1027G72-HA	ND	ND
	MB0918G72-19	ND	ND
	MB0918G72-20	<1	ND
	MB0922G72-43	ND	5
	MB0922G72-44	ND	ND
	MB0922G72-44A*	ND	ND
MARS SITE			
G-80	MB1002G80-BA	<1	<1
	MB1002G80-CA	ND	ND
	MB1002G80-CB	ND	ND
	MB1002G80-CC	ND	ND
	MB1002G80-CCA ^b	ND	ND
	MB1002G80-CE	ND	ND
	MB1002G80-CF	ND	ND
	MB1002G80-CFA ^b	<1	<1
	MB1002G80-CG	<1	<1
	MB1002G80-CH	<1	<1
	MB1002G80-EA	ND	ND
	MB1002G80-EB	ND	ND
	MB1002G80-AA	ND	ND
	MB1002G80-GA	2	ND
	MB1002G80-GAA ^b	ND	ND
	MB1002G80-GB	ND	ND
	MB1002G80-GC	5	ND
	MB1002G80-GD	2	ND
	MB1002G80-GDA ^b	2	ND
	MB1002G80-HA	40	ND
	MB1002G80-HB	ND	ND
	MB1002G80-HC	ND	ND
	MB1002G80-HD	<1	<1
G-81	MB1003G81-CA	ND	ND
	MB1003G81-HA	ND	ND
	MB1003G81-HB	ND	ND
	MB1003G81-HC	ND	ND
	MB1003G81-HD	ND	ND

Table D-1. (Cont'd)

Building Number	Sample Number	% Asbestos	
		Chrysotile	Amosite
MARS SITE (Cont'd)			
	MB1003G81-GA	ND	ND
	MB0918G81-21	ND	ND
	MB0918G81-22	5	ND
G-82	NO SAMPLES		
G-83	NO SAMPLES		
G-84	MB1003G84-EA	ND	ND
	MB1003G84-EB	ND	ND
	MB1003G84-CA	ND	ND
	MB1003G84-CAA ^b	VOID ^d	
G-85	NO SAMPLES		
G-86	MB1003G86-AA	ND	20
	MB1003G86-AB	ND	35
	MB1003G86-AC	ND	25
	MB1003G86-AD	15	ND
	MB1008G86-EA	ND	ND
	MB1003G86-EA	ND	ND
	MB1003G86-EAA ^b	ND	ND
	MB1008G86-EB	ND	ND
	MB1008G86-EC	ND	ND
	MB1008G86-ED	ND	ND
	MB1008G86-GA	2	ND
	MB1003G86-HA	15	ND
	MB1003G86-HB	30	ND
	MB0918G86-23	2	ND
	MB0198G86-24	ND	ND
	MB1003G86-25	ND	25
G-87	MB1003G87-EA	ND	ND
G-88	NO SAMPLES		
G-89	NO SAMPLES		
G-90	NO SAMPLES		
G-91	MB1003G91-EA	ND	ND
	MB1003G91-EAA ^b	VOID ^d	

^dVOID means the sample was destroyed in shipment to the analytical laboratory.

Table D-1. (Cont'd)

Building Number	Sample Number	% Asbestos	
		Chrysotile	Amosite
MARS SITE (Cont'd)			
G-94	NO SAMPLES		
G-95	NO SAMPLES		
MISCELLANEOUS			
G-92	MB1003G92-CA	ND	ND
G-100	NO SAMPLES		
BARSTOW SITE			
	MB1029BSTW-CD	ND	ND
	MB1029BSTW-EA	ND	ND
	MB1029BSTW-EB	ND	ND
	MB1029BSTW-EC	ND	ND
	MB1029BSTW-GA	30	ND
	MB1029BSTW-GB	2	ND
	MB1029BSTW-GC	ND	ND
	MB1029BSTW-2	ND	ND
	MB1029BSTW-2A	ND	ND
	MB1029BSTW-3	ND	ND
	MB1029BSTW-1	ND	ND
APOLLO SITE			
A-1	NO SAMPLES		
A-2	MB1008A2-AA	ND	ND
	MB1008A2-AB	ND	ND
	MB1008A2-EA	ND	ND
	MB1008A2-EB	ND	ND
	MB1009A2-EA	ND	ND
	MB1009A2-EB	ND	ND
	MB1009A2-EC	ND	ND
	MB1009A2-ED	ND	ND
	MB1009A2-HA	ND	ND
	MB1009A2-HAA ^b	ND	ND
	MB1009A2-GA	2	ND
	MB1009A2-GB	5	ND
	MB1009A2-GC	2	ND
A-3	NO SAMPLES		
A-4	MB1027A4-AA	ND	ND

Table D-1. (Cont'd)

Building Number	Sample Number	% Asbestos	
		Chrysotile	Amosite
APOLLO SITE (Cont'd)			
A-5	MB1003A5-HA	60	ND
	MB1003A5-HB	40	ND
A-6	NO SAMPLES		
A-7	MB1008A7-CA	ND	<1
A-8	MB1008A8-BA	30	ND
	MB1008A8-BAA ^b	25	ND
A-12	MB1003A12-HA	ND	ND
A-85	MB1008A83-CA	ND	ND
A-86	NO SAMPLES		
A-87	MB1008A87-HA	ND	ND
A-88	NO SAMPLES		
MOJAVE BASE SITE			
M-1	RB1007M1-GA	ND	ND
	RB1007M1-GB	2	ND
	RB1007M1-GC	<1	ND
	RB1007M1-EA	ND	ND
M-2	RB1007M2-GA	3	ND
	RB1007M2-GB	<1	ND
	RB1007M2-CA	ND	ND
M-3	NO SAMPLES		
M-4	NO SAMPLES		
M-5	NO SAMPLES		
M-6	RB1007M6-GA	2	ND
	RB1007M6-BA	15	ND
	RB1007M6-AA	10	ND
M-7	NO SAMPLES		
M-8	RB1007M8-HA	15	ND
	RB1007M8-HB	ND	ND
	RB1007M8-HC	<1	ND
	RB1007M8-EA	ND	ND

Table D-1. (Cont'd)

Building Number	Sample Number	% Asbestos	
		Chrysotile	Amosite
MOJAVE BASE SITE (Cont'd)			
	RB1007M8-EB	ND	ND
	RB1007M8-EC	ND	ND
	RB1007M8-GA	ND	ND
	RB1007M8-GB	2	ND
M-9	RB1007M9-HA	35	ND
	RB1007M9-GA	2	ND
	RB1007M9-BA	ND	ND
	RB1007M9-BB	ND	ND
M-10	NO SAMPLES		
M-12	NO SAMPLES		
M-13	NO SAMPLES		
M-17	NO SAMPLES		
M-50	NO SAMPLES		
DUMP SITE	MB1030MOJAVE-HA	<1	<1
	MB1030MOJAVE-HB	<1	<1
	MB1030MOJAVE-HC	<1	<1

APPENDIX E

BIBLIOGRAPHY OF PERTINENT REGULATORY DOCUMENTS
DEALING WITH ASBESTOS

BIBLIOGRAPHY OF PERTINENT REGULATORY DOCUMENTS
DEALING WITH ASBESTOS

Dale L. Keyes and Bertram P. Price. Guidance for Controlling Friable Asbestos-Containing Materials in Buildings, Battelle Memorial Institute, Columbus Division, Washington, D.C., EPA 560/5-83-002, March 1983.

U.S. EPA. Interim Method for the Determination of Asbestos in Bulk Insulation Samples; EPA 600/M4-82-020; U.S. EPA Environmental Monitoring Systems Laboratory; Research Triangle Park, North Carolina 27711; December 1982.

U.S. EPA. Guidance for Controlling Friable Asbestos-Containing Materials in Buildings; EPA 560/5-83-002; U.S. EPA, Washington, D.C. 20460; March 1983.

U.S. EPA. Support Document for Proposed Rule on Friable Asbestos-Containing Materials in School Buildings, Health Effects and Magnitude of Exposure; EPA 560-12-80-003; U.S. EPA, Washington, D.C. 20460; October 1980.

U.S. EPA Regulations in 43 Federal Regulation (FR) 26372 and 47 FR 23360.

OSHA Regulations in 51 FR 119, pp. 22612-22790, June 20, 1986. Current Interim Emergency Standards.

CAL/OSHA Regulations in Title 8, 5208, pp. 442.1-3. August 13, 1985.

Publications issued by the National Asbestos Training Center, University of Kansas, Lawrence, Kansas.

APPENDIX F

LETTER AND ACKNOWLEDGMENT SHEET
CONCERNING ASBESTOS AWARENESS
SENT BY J. E. McPARTLAND, MANAGER
OF THE GDSCC, TO ALL GDSCC EMPLOYEES

Memorandum

Allied-Signal Aerospace Company

Bendix Field Engineering Corporation
850 East Main Street
Barstow, CA 92311



Date: 16 June 1989
To: All Personnel
From: J. E. McPartland
Subject: Asbestos Awareness

The first asbestos awareness training program for all personnel at the Goldstone Deep Space Communications Complex (GDSCC) was conducted during the months of September and October 1986. The content of the training course included:

- * Description of asbestos - containing materials.
 - History of use
 - Type of material which may contain asbestos
- * Health hazards associated with asbestos.
- * Explanation of current legislation/regulations concerning asbestos.
- * The need for good housekeeping practices.
- * The need for utilizing personal protective equipment and respiratory protection (appropriate occasions for use).
- * Training material hand-outs.

However, on January 1, 1989, a new law (AB 3713) became effective in California which requires owner or agents of buildings constructed prior to 1979 to notify their employees in writing, individually about the presence and possible health impacts of asbestos in those buildings.

In order to be in compliance with this new law we must provide you with the following information:

1. Asbestos surveys:

Two asbestos field surveys have been conducted at the GDSCC to determine the existence and location of asbestos-containing materials in the buildings. The surveys were performed in April 1987 and in September 1987. A copy of this survey report called "Environmental Projects: Volume 4, Asbestos Survey, JPL Publication 87-4, dated February 1, 1988, Goldstone Deep Space Communication Complex, is available for your review at the office of the Environmental Protection Coordinator at the GDSCC, anytime during normal day time working hours.

2. Description of the Asbestos-Containing Materials:

The asbestos survey of the GDSCC identifies the general locations and provides approximate quantities of non-friable (bonded or encapsulated) asbestos-containing materials in buildings and structures. Friable asbestos-containing material was removed from the GDSCC in April 1989. Non-friable asbestos-containing materials may be found in the following areas:

Bldg. No.	Siding (SF)	Roofing (SF)	Walls (SF)	Ceiling (SF)	Floors (SF)
G-21	0	0	0	0	7,700
G-23	0	0	0	0	2,443
G-24	0	0	0	0	1,294
G-25	0	0	0	0	240
G-26	0	0	672	0	1,831
G-33	0	0	0	0	3,310
G-36	0	0	0	0	289
G-37	0	0	0	0	492
G-38	0	0	0	0	5,849
G-42	0	0	0	0	577
G-44	812	0	0	0	0
G-45	0	0	0	0	111
G-47	0	0	0	0	1,247
G-51	0	0	1120	0	1,806
G-53A	0	0	0	0	676
G-56	0	0	0	0	100
G-70	0	360	0	0	0
G-71	0	0	0	0	360
G-72	0	2880	0	0	2,391
G-80	0	0	0	0	3,000
G-81	0	5000	0	0	0
G-86	0	1440	768	0	7,150
G-93	0	0	0	0	270
Barstow	0	0	0	0	23,212
A-1	0	0	0	0	4,116
A-2	0	0	0	0	3,400
A-7	0	0	256	0	0
A-8	0	128	0	0	0
M-1	0	0	0	0	16
M-2	0	0	0	0	840
M-6	0	4729	0	0	778
M-9	0	0	0	0	160
M-8	0	128	0	0	1,344

As seen from a review of this report the survey team was as thorough as possible in its investigation; however, it is possible that some existing asbestos-containing material was not found. The primary reasons for failure to find existing asbestos-containing materials are as follows:

1. The asbestos containing material is substantially inaccessible, e.g., within walls, crawl spaces, trenches, roof structures.
2. The asbestos-containing material is a relatively small portion of an equipment, appliance or structure item. For example, heating elements may have interior asbestos material lining, valve glands may have asbestos and graphite packing, etc.
3. The asbestos-containing material is underground.

Due care should be taken during demolition, repair and remodeling operations to confirm the presence of such hidden asbestos-containing materials and measures must be taken for protecting potentially exposed workers.

Handling Asbestos-Containing Materials:

Asbestos has been very useful in many products, from ceiling and floor tiles to car brakes and clutches. But now we know it can be hazardous to your health if you inhale its fibers.

Do not enter an asbestos work area or disturb any asbestos-containing materials unless you have been authorized to do so; provided with the proper protective clothing and properly trained.

Please contact the Environmental Protection or Safety Office if you have any questions.

ACKNOWLEDGEMENT

I hereby acknowledge that I have received and read the "Asbestos Awareness" letter dated June 16, 1989 concerning the presence of asbestos containing materials on the Goldstone Deep Space Communications Complex.

Print Name

Badge Number

Location

Employee Signature

Date Signed

Immediate Supervisor's Signature

Date Signed

This acknowledgement (the employee may keep the letter) **MUST BE COMPLETED, SIGNED AND RETURNED** to the Environmental Protection Office no later than July 15, 1989.

APPENDIX G

GROUPS INVOLVED IN THE
FRIABLE-ASBESTOS REMOVAL
WORK AT THE GDSCC

FRIABLE-ASBESTOS ABATEMENT WORK AT THE GDSCC

GROUPS INVOLVED IN THE FRIABLE-ASBESTOS REMOVAL WORK AT THE GDSCC

Two asbestos surveys at the GDSCC were carried out in 1986 and 1987 by M. B. Gilbert Associates (MBGA), Long Beach, California. In December 1987, after these two surveys, a Preliminary Engineering Report (PER) describing the work that was necessary to remove friable asbestos from the GDSCC was submitted to the Jet Propulsion Laboratory by Engineering Science, Inc., Pasadena, California.

The friable-asbestos abatement program, conducted at the GDSCC from December 21, 1988 to its end on May 11, 1989, was performed by the following groups:

1. Jenkins Construction Company, Long Beach, California.
Prime Contractor for the correction of environmental problems at the GDSCC, including asbestos abatement.
2. Engineering-Science, Inc., Pasadena, California.
Engineering overseer of the work to correct environmental problems at the GDSCC, including asbestos abatement.
3. K&D West, Inc., Torrance, California.
In charge of air monitoring and related safety and health inspections during friable asbestos removal procedures at the GDSCC.
4. Ted's Industrial Insulation, Inc., La Habra, California.
Actually performed the removal of friable asbestos and also re-insulated cleaned pipes and fittings with black, foam-rubber insulation (Armaflex) and with colorless fiberglass.
5. National Abatement Technology Center (NATEC)/Analytical Microscopy Laboratories (AML), Rosemead, California.
Using phase contrast microscopy, performed counts of asbestos fibers from 16 air samples taken during the friable-asbestos abatement program at the GDSCC. One sample, that involved asbestos fibers in water, was analyzed using a transmission electron microscope.
6. National Environmental Corporation, Downey, California.
Hauled friable asbestos debris out of the GDSCC to a hazardous material landfill in Joseph City, Arizona.

Supplemental records, including the actual field reports of the friable asbestos abatement program at the GDSCC are published as an internal JPL document. If you wish to receive a copy, write to Ezra Abraham, Jet Propulsion Laboratory, 4800 Oak Grove Drive, M.S. 144-201, Pasadena, California 91109-8099.

APPENDIX H

UNIFORM HAZARDOUS WASTE MANIFEST FOR THE
TRANSPORT OF FRIABLE ASBESTOS DEBRIS FROM
THE GDSCC TO A HAZARDOUS WASTE LANDFILL IN
JOSEPH CITY, ARIZONA

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No.

Manifest Document No.

2. Page 1 of

Information in the shaded areas is not required by Federal law.

3. Generator's Name and Mailing Address

NASA/PL - JUSTINE T. ...
P.O. BOX 997 BARSTOW, CALIF. 92311

4. Generator's Phone () 334-5330

5. Transporter 1 Company Name

NATIONAL ENVIRONMENTAL CORP.

6. US EPA ID Number

CAD981438146

7. Transporter 2 Company Name

NATIONAL ENVIRONMENTAL

8. US EPA ID Number

CAD981438146

9. Designated Facility Name and Site Address

PEN-ROB CORP. LANDFILL
3MI NO/I-40, EASTSIDE OF PORTER AVE.
JOSEPH CITY, AZ 86032

10. US EPA ID Number

AZC0000000150

A. State Manifest Document Number

88628549

B. State Generator's ID

C. State Transporter's ID

D. Transporter's Phone

E. State Transporter's ID

F. Transporter's Phone

G. State Facility's ID

H. Facility's Phone

800-292-9230

11. US DOT Description (Including Proper Shipping Name, Hazard Class, and ID Number)

12. Containers
No. Type

13. Total Quantity

14. Unit
Wt/Vol

1. Waste No.

a. "R.Q." HAZARDOUS WASTE SUBSTANCE, SOLID, n.o.s.
NA9188 [ASBESTOS] ORM-E

0216030160

P

State 151

EPA/Other

b. "R.Q." HAZARDOUS WASTE SUBSTANCE, SOLID, n.o.s.
NA9188 [ASBESTOS] ORM-E

021603024180

P

State

EPA/Other

c.

State

EPA/Other

d.

State

EPA/Other

J. Additional Descriptions for Materials Listed Above

K. Handling Codes for Wastes Listed Above

a. 03

b. 03

c.

d.

15. Special Handling Instructions and Additional Information

DO NOT BREAK BAGS OR CAUSE DUST. AVOID BREATHING DUST.
BURY SEPARATELY AND COVER WITH BACKFILL.

16.

GENERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name

David C Roberts

Signature

David C Roberts

Month Day Year

04/06/89

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name

Jesse J Garcia

Signature

Jesse J Garcia

Month Day Year

04/06/89

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name

Penrod

Signature

Penrod

Month Day Year

04/07/89

19. Discrepancy Indication Space

20. Facility Owner or Operator Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.

Printed/Typed Name

TOM PENROD

Signature

Tom Penrod

Month Day Year

04/08/89

88628549

IN CASE OF AN EMERGENCY OR SPILL, CALL THE NATIONAL RESPONSE CENTER 1-800-424-8802; WITHIN CALIFORNIA CALL 1-800-852-7550

GENERATOR

TRANSPORTER

FACILITY

